AUTHORS GUIDELINES

Aims and Scope
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.

Submission of Articles
Articles should be sent to the Editor, African Union/Interafrican Bureau for Animal Resources, E-mail: bahpa@au-ibar.org.

Manuscripts should be in clear concise English or French, typewritten with double spacing and adequate margins. The spelling should be that of The Oxford English Dictionary or Le Petit Robert.

An article submitted for publication implies that its content has not been published elsewhere and that it is subject to editorial revision.

Types of Articles Published in the Bulletin
- Full papers providing accounts of original work.
- Short Communications.
- Review articles invited by the Editor.
- Editorials.
- Letters to the Editor.
- Book Reviews.
- News and announcements.

Format for Articles
The manuscripts should contain the following features:
Every line on the text should be numbered.
Title, which should be concise, not more than 15 words long, followed by the author(s) name(s) and institutions to which work should be attributed and address for correspondence, if different.

Abstract not exceeding 200 words giving a synopsis of the findings presented and the conclusion(s) reached.

Introduction stating the purpose of the work.

Materials and Methods used.

Results presented concisely.

Discussion of significance.

Acknowledgements.

References numbered consecutively in the order they are first mentioned in the text. Identification of references in the text should be by numbers (in parentheses) and not by authors' names.
BULLETIN OF ANIMAL HEALTH AND PRODUCTION IN AFRICA
VOL. 55 NO. 2 JUNE 2007

CONTENTS

INTER-AFRICAN BUREAU FOR ANIMAL RESOURCES
BUREAU INTERAFRICAIN DES RESSOURCES ANIMALES
P.O. Box 30786, NAIROBI, KENYA

BULLETIN

June 2007

Volume 55

No. 2

AFRICAN UNION
UNION AFRICAINE
IBAR PUBLICATION
PUBLICATION DE L'IBAR

BULLETIN OF ANIMAL HEALTH AND PRODUCTION IN AFRICA
BULLETIN DE LA SANTE ET DE LA PRODUCTION ANIMALES EN AFRIQUE

A Quarterly Journal of Original Articles and Abstracts in English and French

Annual subscription: US$ 50.00

ISSN 0378-9721

Revue trimestrielle contenant des articles originaux et des résumés d'études en anglais et en français
Abonnement pour un an: 50 $EU
<table>
<thead>
<tr>
<th>Original Articles</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Clinical and serological evidences for the presence of rabbit encephalitozoos</td>
<td></td>
</tr>
<tr>
<td>nosis in Nigeria - E.A. Okewole</td>
<td>82</td>
</tr>
<tr>
<td>2. Serological and Microbiological Studies of Contagious Caprine Pleuropneumonia</td>
<td></td>
</tr>
<tr>
<td>in Selected Districts of Tanzania - L.J.M. Kusiluka, S.J. Kimaryo, G.R.M.</td>
<td></td>
</tr>
<tr>
<td>Nsengwa, R.R. Kazwala and D.M. Kambarage</td>
<td>88</td>
</tr>
<tr>
<td>3. Molecular molecular assessment of African Swine Fever in North-Central Nigeria</td>
<td></td>
</tr>
<tr>
<td>Obisakin and D. Shamaki</td>
<td>96</td>
</tr>
<tr>
<td>4. Etude des lésions rencontrées sur des carcasses de petits ruminants à l’abattoir</td>
<td></td>
</tr>
<tr>
<td>de Togblékopé à Lomé au Togo - A. E. Kulo et K. Seme</td>
<td>104</td>
</tr>
<tr>
<td>5. Assessment of hygienic quality of camel (Camelus dromedarius) milk in Khartoum</td>
<td></td>
</tr>
<tr>
<td>6. Effets de la cuisson ou de l’extrusion du niébé (Vigna unguiculata) sur les</td>
<td></td>
</tr>
<tr>
<td>performances de production des poulets de chair en finition A. TEGUIA, V.P.</td>
<td>118</td>
</tr>
<tr>
<td>CHAKAM et J. TCHOUUMBOUE</td>
<td></td>
</tr>
<tr>
<td>7. First lactation performance and crossbreeding effects of frieshian x boran</td>
<td></td>
</tr>
<tr>
<td>crosses in Tanzania - H.W. Mwatawala and G.C. Kifaro</td>
<td>128</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Short Communications</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8. An abattoir study of caprine mastitis in Bauchi, Nigeria - D. Zahraddeem, I.</td>
<td>138</td>
</tr>
<tr>
<td>S. R. Butswat, D.J.U.Kalla and A. Sani</td>
<td></td>
</tr>
<tr>
<td>9. Isolation of Highly Pathogenic Avian Influenza (HPAI) H5N1 in the Sudan -</td>
<td>142</td>
</tr>
<tr>
<td>Selma, O.A. and Jeddah, I.E</td>
<td></td>
</tr>
<tr>
<td>10. Comparative Physiological Parameters in West African Dwarf and Yankasa Sheep</td>
<td>146</td>
</tr>
<tr>
<td>Adewumi, O.O. Chineke C.A, Alokante, J.A. and Bakare, A.O.</td>
<td></td>
</tr>
</tbody>
</table>
CLINICAL AND SEROLOGICAL EVIDENCES FOR THE PRESENCE OF RABBIT ENCEPHALITOZOOONOSIS IN NIGERIA

E.A. Okewole

Small and Laboratory Animal Unit, Department of Veterinary Medicine, University of Ibadan, Ibadan, Nigeria.

DES PREUVES CLINIQUES ET SEROLOGIQUES DE LA PRESENCE DE L'ENCEPHALITOZOOONSE CHEZ LES LAPINS AU NIGERIA

Résumé

Un groupe de 10 lapins blancs de la Nouvelle Zélande âgés de 8 à 15 semaines, achetés dans divers endroits mais acclimatés ensemble pendant plus de 5 semaines avant leur utilisation aux fins de recherche, ont été déclarés malades avec des signes cliniques et notamment des troubles neurologiques relatifs à l'encéphalitozoonose. Deux des lapins qui sont morts le jour de déclaration de la maladie étaient nécropsiés et ils avaient des lésions macroscopiques et microscopiques, qui correspondaient à l'encéphalitozoonose.

Les titres utilisés pour le test d'immunoperoxidase des 8 autres lapins étaient très élevés et variaient entre 626 et 2044, ce qui confirme le diagnostic de l'encéphalitozoonose.

Le traitement au fenbendazole par voie orale, au dexaméthazone par voie parentérale, à l'oxytetracycline et aux multivitamines par injection n'ont pas permis de traiter l'encéphalitozoonose, probablement à cause de l'état chronique de la maladie et à d'autres complications latentes, ou à cause du traitement tardif puisque 5 lapins les plus chroniquement affectés sur 8 sont morts au cours du traitement.

On a souligné le potentiel zoonotique de la maladie et le risque qu'elle représente pour les vétérinaires, les éleveurs, les animaux de laboratoire et les manipulateurs de produits, en particulier ceux qui ont une faible immunité.

Summary

A group of ten 8 to 15-week-old New Zealand white rabbits differently bought but communally acclimatized for over 5 weeks prior to their research use was reported sick with clinical signs including neurological derangements that were suggestive of encephalitozoonosis. Two of the 10 that died on the day of report were examined post mortem and both the gross and micro pathological lesions were consistent with encephalitozoonosis.

Immunoperoxidase test titres of the remaining 8 were very high and ranged from 626 to 2044 to confirm a definitive diagnosis of encephalitozoonosis.

Treatment with oral fenbendazole, parenteral dexamethazone, injectable multivitamins and oxytetracycline did not achieve much, probably due to the chronic nature of the disease, other latent complications or the late treatment intervention as 5 most chronically affected of the 8 rabbits died late in the course of treatment.

The zoonotic potentials of the disease and the hazard posed to veterinarians, farmers and laboratory animal and products handlers especially the immunocompromised were highlighted.
Introduction

Encephalitozoonosis in rabbits is caused by an obligate intracellular microsporidial protozoan parasite; Encephalitozoon cuniculi, which infect a wide range of mammals, including humans. E. cuniculi infects very young rabbits causing chronic inflammation that results to granulomatous lesions in the brain, kidney and sometimes liver, which manifest clinically as sudden death, seizures, ataxia, torticollis, uveitis, nystagmus, encephalitis (vestibular disease) and chronic renal failure\(^1\). Diarrhoea, renal disease and keratoconjunctivitis could be additional signs in the infected humans. Infective spores of E. Cuniculi are shed in the urine of infected rabbit and can transmit infection between individuals\(^2\), while intrauterine infection manifesting as uveitis had been reported\(^3,4\).

Because of its early infection and chronic inflammatory granulomatous lesions, encephalitozoonosis is usually asymptomatic in a large number of infected, but of a high mortality rate in the symptomatic few\(^1\).

Following the successful in-vitro cultivation of E. cuniculi and preparation of a pure antigen suspension\(^5,6\), several serological methods were developed for the detection of circulating antibodies against the parasite. These assays included the indirect immunofluorescence test\(^7\), complement fixation test\(^8\), skin test\(^9\), carbon immunoassay\(^10\), immunoperoxidase test\(^11\) and enzyme immunoassay\(^12\). The type of facilities available, state of the sick animals, skill or competence of the diagnostician and the purpose of the animal which again influences the mandate of the owner to diagnosticians largely influences the choice of diagnostic assay.

The objective of this study was to undertake a very comprehensive diagnosis of rabbit encephalitozoonosis with the view to confirm the existence or otherwise of this zoonosis in Nigeria and also highlight the dangers posed to the young rabbit industry.

Materials and methods

Case history: In October 2004, a group of ten (8 to 15-week-old) New Zealand white rabbits from the Biochemistry Department of the University of Ibadan was reported sick and unthrifty in the course of their acclimatization before experimental use. Anamnesis included that they were bought from different open markets as weaners five weeks earlier and were kept together in the Departmental communal large cage for acclimatization. Two of the rabbits died on the day of presentation after protracted seizures on sternal recumbency.

Clinical examination

A through clinical examination was done on the 8 rabbits.

Postmortem examination

The two rabbits that died on the day of presentation were opened up for the postmortem examination.

Histopathological techniques

The brain, liver and kidney sections were fixed in 10% formol saline, embedded in paraffin and stained with haematoxylin-eosin by Gram's methods.

Sero logical confirmation

The immunoperoxidase test as earlier described by canon\(^11\), was used for the serological investigation. This method was
adopted because it doesn’t require an ultraviolet microscope and also allows permanent preparation of smears for future references and teaching.

Sera:

The 8 rabbits were first identified with numbers; R1 to R8 and 3.0ml of blood was taken from the ear vein of each into sterile tubes for serology. After clotting for one hour at room temperature, serum was harvested after centrifugation for 10 minutes at 1000g and stored at -20°C.

Antigen preparation

The *E. cuniculi* (E. 614c) donated by the onderstepoort veterinary Academic Hospital was serially passaged in the laboratory mice. Spores from infective fluid were inoculated into MDCK cell cultures⁶ spores were harvested by centrifugation, discard of media and resuspension in phosphate buffered saline (PBS) of pH 7.2. Concentration of spores was done by serial centrifugation and addition of PBS, using a haemocytometer under phase contrast microscopy, until a concentration of 106 spores per milliliters was achieved. Two rows of 6 wells of the antigen were prepared on a PTFE-coated slide, allowed to dry, fixed by gentle heat and kept at -70°C until assayed.

Positive and negative controls

The commercial positive and negative control sera, (Testman, Uppsala, Sweden) were used for the assay.

Immunoperoxidase (IP) test

Details of sera dilution, cleaning the antigen treated slides, antigen antibody reaction, incubation, washings and blottings were done as described by Ganon⁷. Slides were fixed on with cover slips, using the mounting medium and examined under a light microscope x 10 objectives.

Positive wells had dark-brown staining aggregations of spores while the negative ones had no stains. The first titre that was considered positive at the titration dilution was 16, giving the similarities of the antigen concentration to those earlier by Ganon⁷.

Results

Clinical findings

Observations included gradual emaciation, inappetence, lethargy, passage of brownish-yellow urine under stress, head tilt, seizures, ataxia, stargazing, swaying at rest and purulent conjunctivitis.

Clinical findings included muscular weakness in all the 8, uveitis in 3, nystagmus in 8, wryneck in 5, vestibular defect in 6, uneaten caecotrophs in 8 and evidence of renal failure e.g. urinary incontinence and stressful urination in all the 8.

Postmortem examination findings

Gross lesions were restricted to the brain, eye and the kidneys and consisted of pitted or depressed spots, suggestive of spot fibrosis on the kidney cortex and enlarged fluid-filled brain stem suggestive of *hydrocephalus internus*. Purulent conjunctivitis was observed on the two rabbits.

Histopathological findings

Histopathological findings of the brains included granulomas in both the grey and white matter consisting of a necrotic center surrounded by mononuclear and glial cells.
viz. lymphocytes, plasma cells and histiocytes. Blood vessels around granulomas showed perivascular lymphocytic and plasma cells cuffing. Some deeply stained rod-like organisms were seen scattered on and around the granulomas. Kidneys showed evidences of interstitial nephritis, tubular and glomerular degeneration and some hyaline casts on the tubules. There were also mononuclear cell infiltrations of the cortex as well as two glomerula with perivascular cuffing. mononuclear cells (lymphocytes and plasma cells) infiltrated the liver interstitium only.

Results of IP test
The titres were generally high and ranged from 626 to 2044 in the 8 rabbits. Two rabbits, R3 and R5 had very low titres (table 1). All the 8 rabbits were seropositive for encephalitozoonosis.

Clinical tentative diagnosis
On the bases of;
(a) An anamnesis that included purchase at different open markets and communal management in a cage.
(b) The susceptible age range (8-15weeks)
(c) The characteristic neurological clinical signs
(d) Suggestive gross and microhistological lesions in the brains and kidneys, a tentative diagnosis of encephalitozoonosis was made.

Definitive diagnosis and treatment
On the bases of anamnesis, clinical signs, histopathological and serological findings, a definite diagnosis of encephalitozoonosis was made. Clinical management was reviewed in the light of this diagnosis to include oral fenbendazole (Panacur®-Hoescht, Germany) at a dose rate of 20mg/kg. body weight, (b.w) for 4 weeks\(^{13}\) and parenteral Dexamethasone at 2mg/kg b.w., injectable vitamins and oxytetracycline at a dose of 15mg/kg b.w. for 1 week\(^{14}\). Unfortunately, therapy achieved only a temporary clinical but not pathological cure as five of the 8 rabbits died on day 12 of treatment while the remaining 3 (R2, R3 & R5) recovered after a long convalescence.

Discussion
Encephalitozoonosis was suggested by both the anamnesis and clinical findings and the same was corroborated by both the histopathology and serology. This meticulous approach to diagnosis was necessary to avoid a misdiagnosis of

<table>
<thead>
<tr>
<th>Rabbit Number</th>
<th>R1</th>
<th>R2</th>
<th>R3</th>
<th>R4</th>
<th>R5</th>
<th>R6</th>
<th>R7</th>
<th>R8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Titres</td>
<td>1824</td>
<td>1412</td>
<td>626</td>
<td>1624</td>
<td>864</td>
<td>2044</td>
<td>1884</td>
<td>1924</td>
</tr>
</tbody>
</table>
pasteurellosis, toxoplasmosis, otitis media/interna or vitamin E/selenium deficiency that are well recognized differential diagnoses to the case on the basis of neurological signs\textsuperscript{1,15}.

Encephalitozoonosis has a worldwide clinical significance not only for its zoonotic potentials, especially in the immunocompromised humans like those with the acquired immune deficiency syndrome (AIDS)\textsuperscript{16,17} but also for its highly devastating chronic inflammatory spread, among the high-stocking and extensively-managed young rabbits. In Africa, the public health significance had been much emphasized in the earlier case reports\textsuperscript{18,19,20} on this zoonosis. This emphasis underscores the need for a higher level of hygiene including the use of household disinfectants by children and the immunocompromised adults in the handling of rabbit houses, utensils and other items contaminable by rabbit urines including the carcasses for the postmortem examinations.

According to Harcourt-Brown\textsuperscript{1}, \textit{E. cuniculi} spreads by the infective polar microsporidal spores that are ingested from the contaminating urine of infected rabbits. Once in the alimentary tract, it infects by extruding the polar filament into the vacuole in the host epithelial cells, where it multiplies rapidly to distend and rupture eventually to infect new cells and organs. It is the rupture of cells that is associated with inflammation and the development and spread of granulomas to target organs like the brain, liver and particularly kidney which shed the organism in urine. It is the shedding of infective spores in urine\textsuperscript{2} that is probably responsible for the spread of the disease in most rabbitries and even in this particular case for the spread among the free-source rabbits communally acclimatized together in an urine-contaminated cage for a period of over 5 weeks.

The reliability of a sero test for the confirmation of a clinical diagnosis of encephalitozoonosis has been questioned severely since Lyngset\textsuperscript{21} had reported that naturally-infected young rabbit seroconvert at 8-10 weeks and that antibody titre (as against type) might just be an indication of exposure rather than \textit{E. cuniculi} as a cause of disease. However, several reports\textsuperscript{2,11,22} had consistently justified the use of serology for the diagnosis on the basis of a much higher antibody level in the chronic disease than at the mere exposure level. One of these reports\textsuperscript{22} infact justified this with an assessible experimental infection, while others\textsuperscript{11,23}, using an immunoperoxidase and immunofluorescence techniques respectively got comparably high titres, which was described as been characteristic of the encephalitozoonosis disease\textsuperscript{11}.

In the light of this, it is most probable that the relatively low titres of rabbits R3 and R5 in table 1 reflected a relatively recent infection.

Treatment with Dexamethazone was directed at the suppression of inflammation, while the oxytetracycline and febendazole regimens were both to kill the organism in vivo\textsuperscript{13,14}. While the efficacy of the regimens are not in doubt, the chronic nature of the case coupled with other complications reduced its effectiveness with attendant case mortality rate of 62.5%.

**Acknowledgements**

I wish to thank Dr. A. Robert of the Department of Biochemistry of the University of Ibadan for his technical
assistance and Messrs G. Olawuwo and A. Aremu of the Faculty experimental animal unit for the care of the rabbits while on admission.

References


Received for publication on 09th August, 2005.
SEROLOGICAL AND MICROBIOLOGICAL STUDIES OF CONTAGIOUS CAPRINE PLEUROPNEUMONIA IN SELECTED DISTRICTS OF TANZANIA

1L.J.M. Kusiluka, 1S.J. Kimaryo, 2G.R.M. Nsengwa, 1R.R. Kazwala and
1D.M. Kambarage

1Department of Veterinary Medicine and Public Health, Sokoine University of
Agriculture, P.O. Box 3021, Morogoro, Tanzania
2Veterinary Investigation Centre, Ministry of Livestock Development,
P.O. Box 126, Iringa, Tanzania

ETUDES SEROLOGIQUES ET MICROBIOLOGIQUES DE LA PLEUROPNEUMONIE CONTAGIEUSE CAPRINE DANS CERTAINS DISTRICTS DE LA TANZANIE

Résumé

Des études sérologiques et microbiologiques ont été menées pour enquêter sur la présence de la pleuropneumonie contagieuse caprine (PPCC) dans les districts d’Iringa, de Mwapwa, de Kilosa et de Morogoro en Tanzanie. Au total, 315 chèvres ont fait l’objet d’un examen clinique, tandis que 74 chèvres étaient soumises à une évaluation pathologique. Des prélèvements nasaux (175), des poumons (74), du liquide pleural (35) et des ganglions lymphatiques (29) étaient mis en culture pour l’examen mycoplasmatologique sur un milieu de culture à base de Hayflick et un milieu commercial lyophilisé de diagnostic de PPCC. Au total, 1927 sérum ont fait l’objet d’un examen sérologique à l’aide d’un test d’agglutination en latex. Les principaux traits cliniques des chèvres malades étaient la dyspnée, la toux, l’écoulement nasal mucopurulent et la pyrexie; 60 des 74 chèvres avaient des traits pathologiques de la PPCC. La séropositivité globale dans tous les districts couverts par l’étude était de 53%. M. capripneumoniae était isolé de 18 poumons sur 74, de 12 liquides pleuraux sur 35 et de 6 ganglions lymphatiques sur 31. Les autres espèces de mycoplasme rencontrées étaient M. mycoides LC et M. ovipneumoniae. Le taux d’isolement de M. capripneumoniae était plus élevé sur le milieu de diagnostic de PPCC que sur le milieu à base de Hayflick. Cette étude a confirmé la présence de PPCC dans les districts d’Iringa, de Mwapwa, de Kilosa et de Morogoro en Tanzanie, ce qui indique que la maladie est très répandue dans le pays.

Summary

Serological and microbiological studies were carried out to investigate the presence of contagious caprine pleuropneumonia (CPP) in Iringa, Mwapwa, Kilosa and Morogoro districts, Tanzania. A total of 315 goats were examined clinically and 74 goats were subjected to pathological evaluation. Nasal swabs (175), lungs (74), pleural fluid (35) and lymph nodes (29) were cultured for mycoplasmal examination on Hayflick-based medium and a commercial freeze-dried CPP diagnostic medium. A total of 1,927 sera were screened serologically using the latex agglutination test. The major clinical features of the sick goats were dyspnea, coughing, mucopurulent nasal discharge and pyrexia, and 60 of 74 goats had pathological features suggestive of CPP. The overall seropositivity in all the study districts was 53%. M. capripneumoniae was isolated from 18 of the 74 lungs, 12 of the 35 pleural fluid- and 6 of 31 lymph nodes. Other mycoplasma species were M. mycoides LC and M. ovipneumoniae. The isolation rate of M. capripneumoniae was higher on the CPP diagnostic medium than on the Hayflick-based medium. This study has confirmed the presence of CPP in Iringa, Mwapwa, Kilosa and Morogoro districts of Tanzania thus, indicating that the disease is probably widespread and endemic in the country.

1Corresponding author E-mail: kusiluka@suanet.ac.tz
Introduction

Contagious Caprine Pleuropneumonia (CCPP) caused by *M. capripneumoniae* is one of the most serious diseases of goats especially in Africa, Middle East and Western Asia\(^1\)\(^2\)\(^3\)\(^4\). The disease has been associated with tremendous socio-economic losses in the form of animal deaths, reduced weight gains, reduced market value and high costs of treatment\(^5\)\(^6\). In addition, the disease has a significant impact on international trade of goats and their products\(^7\).

CCPP was first suspected in Tanzania in 1981 when heavy mortalities of goats occurred in Arusha region\(^8\). Although the description of the outbreaks was considered to be ‘contagious caprine pleuropneumonia’, only *M. mycoides* was isolated from clinical cases, thereby indicating that the outbreaks were of other mycoplasma pleuropneumonia but not the classical CCPP. The first confirmed outbreaks of CCPP in Tanzania occurred in 1998 in Arusha, Kilimanjaro, Tanga and Dar es Salaam regions\(^9\) and *M. capripneumoniae* was isolated from the affected goats. It is presumed that the disease was probably introduced into Tanzania from Kenya through cross-border movement of goats between the two countries since CCPP was present in Kenya long before the Tanzanian outbreaks\(^10\)\(^11\)\(^12\)\(^13\).

Since 1998, outbreaks of CCPP have been confirmed in the Coast and Morogoro regions\(^14\). The disease is now suspected to have spread to Dodoma, Iringa, Mbeya and Singida regions\(^15\). However, because of lack of laboratory capacity to confirm the disease by isolation of *M. capripneumoniae*, many descriptions of CCPP-suspected outbreaks in Tanzania are often based on clinical and pathological features. As such, it is difficult to attribute all descriptions and reports of pleuropneumonia-like diseases to CCPP and, it is possible that other syndromes may be involved. Therefore, the aim of this study was to carry out further investigation on the disease occurrence using clinical, pathological, serological and bacteriological evaluations so as to gather more information about its distribution.

Materials and Methods

Study areas and animals

This study was carried out in Iringa Rural, Mwapwa, Kilosa and Morogoro Urban districts where suspected outbreaks of CCPP occurred between 2001 and 2004. In Iringa district, outbreaks were reported in Mtandika and Nyanzwa villages of Mahenge division and, Mafuruto and Malizanga villages of Idodi division. In Mwapwa district, outbreaks were reported in Berege and Chitemo villages of Rudi division and, Chilendu and Singonali villages of Kibakwe division as well as Kisokwe, Ilolo, Changombe villages and the Livestock Production Research Institute (LPRI). In Kilosa, CCPP was suspected in Luhwaji, Majiwa, Mjiili, Msingisi, Rubeho and Ukwamoni villages of Gairo division while, in Morogoro Urban district, outbreaks occurred in Kihonda and Mkundi villages in the peri-urban areas of Morogoro Municipality. The location of the study districts is already described\(^16\).

In all the study districts, small ruminants were kept under the agropastoral system with poor husbandry practices. The number of animal health service providers was inadequate and this, compounded with the lack of reliable transport and veterinary inputs led to poor quality of veterinary services. In addition, in most herds with
CCPP-suspected outbreaks, owners had already treated their animals with antibiotics, especially oxytetracycline and tylosin by the time we went for investigation and sample collection.

Selection of herds for inclusion in the study was based on information available in the district veterinary offices regarding suspected CCPP outbreaks and the herds were visited following consultation with village leaders and resident livestock field officers. On the consent of animal owners, herds with suspected outbreaks and those with previous history of the disease were examined for the disease and appropriate specimens collected.

**Identification of cases and collection of samples**

A total of 123 herds with CCPP-suspected cases were visited and these included 30 in Iringa, 34 in Mpwapwa, 54 in Kilosa and 5 in Morogoro district. Clinical examination and subsequent sampling were based on presence of animals with respiratory problems in the herds. A total of 315 goats were thoroughly examined, with special attention being on respiratory signs such as respiratory distress, coughing, tachypnoea, nasal discharges, reluctance to move, unthriftiness, dullness, and elevated body temperatures. Nasal swabs (175) were then taken aseptically from randomly selected sick goats and in-contact animals and inoculated into the H2SP broth medium immediately after collection.

About 5 ml of blood was aseptically collected from the jugular veins of all sick goats (including slaughter animals) identified to have respiratory disease as well as those with no signs of a respiratory disease for serological evaluation. In total, 1927 sera were collected from the study herds. In addition, following the consent of animal

<table>
<thead>
<tr>
<th>District</th>
<th>Village</th>
<th>No. of samples screened</th>
<th>No. of positive samples</th>
<th>% of positive samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iringa</td>
<td>Mtandika</td>
<td>63</td>
<td>48</td>
<td>57.8</td>
</tr>
<tr>
<td></td>
<td>Nyanzwa</td>
<td>167</td>
<td>78</td>
<td>46.7</td>
</tr>
<tr>
<td></td>
<td>Idodi</td>
<td>86</td>
<td>37</td>
<td>43.0</td>
</tr>
<tr>
<td></td>
<td>Mafuruto</td>
<td>78</td>
<td>39</td>
<td>50.0</td>
</tr>
<tr>
<td></td>
<td>Malizanga</td>
<td>86</td>
<td>39</td>
<td>45.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>500</strong></td>
<td><strong>241</strong></td>
<td><strong>48.2</strong></td>
</tr>
<tr>
<td>Mpwapwa</td>
<td>Berege</td>
<td>178</td>
<td>88</td>
<td>49.4</td>
</tr>
<tr>
<td></td>
<td>Chitemo</td>
<td>123</td>
<td>64</td>
<td>52.0</td>
</tr>
<tr>
<td></td>
<td>Kizokwe</td>
<td>95</td>
<td>42</td>
<td>44.2</td>
</tr>
<tr>
<td></td>
<td>Iilo</td>
<td>60</td>
<td>31</td>
<td>51.7</td>
</tr>
<tr>
<td></td>
<td>Changombe</td>
<td>223</td>
<td>92</td>
<td>41.3</td>
</tr>
<tr>
<td></td>
<td>LPRN</td>
<td>80</td>
<td>35</td>
<td>43.8</td>
</tr>
<tr>
<td></td>
<td>Chilingu</td>
<td>22</td>
<td>11</td>
<td>50.0</td>
</tr>
<tr>
<td></td>
<td>Singonali</td>
<td>77</td>
<td>36</td>
<td>46.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>858</strong></td>
<td><strong>399</strong></td>
<td><strong>46.5</strong></td>
</tr>
<tr>
<td>Kilosa</td>
<td>Gairo</td>
<td>70</td>
<td>48</td>
<td>68.6</td>
</tr>
<tr>
<td></td>
<td>Luhwaji</td>
<td>46</td>
<td>35</td>
<td>76.1</td>
</tr>
<tr>
<td></td>
<td>Majianga</td>
<td>14</td>
<td>10</td>
<td>71.4</td>
</tr>
<tr>
<td></td>
<td>Mijili</td>
<td>64</td>
<td>50</td>
<td>78.1</td>
</tr>
<tr>
<td></td>
<td>Msingisi</td>
<td>61</td>
<td>44</td>
<td>72.1</td>
</tr>
<tr>
<td></td>
<td>Rubebo</td>
<td>26</td>
<td>22</td>
<td>84.6</td>
</tr>
<tr>
<td></td>
<td>Ukwameni</td>
<td>58</td>
<td>44</td>
<td>75.9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>239</strong></td>
<td><strong>253</strong></td>
<td><strong>74.6</strong></td>
</tr>
<tr>
<td>Morogoro</td>
<td>Kihonda</td>
<td>96</td>
<td>54</td>
<td>56.3</td>
</tr>
<tr>
<td></td>
<td>Mkundi</td>
<td>134</td>
<td>68</td>
<td>50.8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>230</strong></td>
<td><strong>122</strong></td>
<td><strong>53.0</strong></td>
</tr>
</tbody>
</table>
owners, some animals were sacrificed for further disease diagnosis through necropsy examination and collection of specimens for bacteriological evaluation. Bacteriological specimens that included lungs, pleural fluids and thoracic lymph nodes were also collected from 74 goats that were encountered at various slaughter points in the study areas. A total of 74 lungs, 35 pleural fluid samples and 29 lymph nodes were submitted for bacteriological evaluation.

In order to maximise mycoplasma recovery rates, pleural fluids were inoculated into the broth medium (H25P) in the field whereas, lung and lymph node specimens were transported in cool boxes to the laboratory at the Faculty of Veterinary Medicine, Sokoine University of Agriculture for further processing.

**Serological analysis**

All the 1,927 serum samples were analyzed by antibody detection LAT using reagents and procedure supplied by the Kenya Veterinary Laboratories, Nairobi. Briefly, about 10 µl of LAT beads were added to an equal volume of serum sample onto a glass plate. The mixture was then rocked for two to three minutes and the glass plate was placed against a dark background and, read as positive or negative depending on the presence or absence of clumping or agglutination of the beads respectively. Because of limitation of reagents, only 226 sera from Kilosa district were also screened by antigen detection LAT as described by March et al. Briefly, 25 µl of serum was aliquoted onto a glass slide and then 3 µl of the latex suspension was added and mixed well. The slide was then gently rocked backwards and forwards and, read after five minutes as positive or negative depending on the presence or absence of an agglutination reaction, respectively.

**Mycoplasma isolation and identification**

**Types of media**

The media used for mycoplasma isolation in this study were the locally prepared Hayflick-based medium enriched with 25% pyruvate, herein abbreviated as H25P and the CCPP diagnostic medium that was kindly donated by Mycoplasma Experience, Surrey (UK). The H25P broth medium was prepared as described by Bölske et al. and the solid medium was prepared as described by Kusiluka et al.

The freeze-dried CCPP diagnostic medium was prepared according to the manufacturer’s instructions. Briefly, this was prepared by melting the agar by placing it in a boiling water bath and allowed to cool slightly before being placed in a 50°C water bath. The diluent was added to the freeze-dried supplement to make up to 25 ml and the mixture agitated gently until the supplement was completely dissolved and then placed in 50°C water bath for 15 minutes. The reconstituted supplement was added to the agar, mixed thoroughly and then 3 ml of the mixture was dispensed into Petri dishes that were placed in an incubator at 37°C for 10-15 minutes and thereafter stored in a refrigerator before use.

**Culture procedures**

About 10 gram of the lung and lymph node tissues were cut into small pieces and placed in a stomacher bag containing 3.6 ml of H25P broth. The samples were grounded for about five minutes and the suspensions were collected and inoculated into H25P broth. Ten-fold serial dilutions of the inoculated broth up to 10-4 were prepared. Similarly, the pleural fluid and nasal swabs that were inoculated in the field
were serially diluted as stated above. All samples were then incubated at 37°C and observed daily for evidence of growth for up to 14 days as indicated by a drop in pH that was characterized by a colour change from pink to yellowish. The 10-2 cultures showing growth were inoculated on solid medium and incubated at 37°C in a humid anaerobic jar with about 5-8% carbon dioxide supplied by a candle.

On CCPP diagnostic medium, about five drops of pleural fluid were poured on the plates, which were then tilted carefully to allow the spread over the agar surface. Excess fluid was removed and the medium was left to dry. The lung or lymph node suspension were similarly inoculated onto the medium and the plates were incubated in anaerobic jar with 9-13% carbon dioxide supplied by Oxoid AnaeroGen (Oxoid, England). The plates were observed daily for up to 7 days for the growth of the characteristic \textit{M. capripneumoniae} colonies\cite{18}.

Single colonies with characteristic mycoplasma appearance were then picked and sub-cultured into H25P broth and, incubated at 37°C overnight followed by preparation of serial dilutions of the cultures as above. The 10-2 dilution culture was used for identification of the mycoplasma using the disc growth inhibition test\cite{19}.

\textbf{Identification of mycoplasma isolates}

For cultures on H25P, identification of the mycoplasma isolates was carried out using the disc growth inhibition test\cite{20,21} and this was carried out by adding 0.5 ml of 10-2 broth culture of the suspected isolate onto plates containing the H25P solid medium. After sucking off excess fluid, the inoculated plates were left to dry at room temperature for 15 minutes, after which antiserum-impregnated discs were placed on each agar plate. The discs that were used were those intended to characterise members of \textit{M. mycoides} cluster (i.e. \textit{M. capripneumoniae}, \textit{M. capricolum}, \textit{M. capri}, \textit{M. mycoides} \textit{LC}, \textit{M. mycoides} \textit{SC} and \textit{Mycoplasma bovine} group 7) and \textit{M. ovipneumoniae}. The plates were then incubated at 37°C and examined daily under a stereo microscope for presence of growth or inhibition zone. The size of the inhibition zone was measured using a ruler from the edge of the disc to where normal colonies started to grow. Presence of a 4-5 mm inhibition zone around the discs impregnated with hyperimmune sera against a specific mycoplasma was considered as a positive identification for the relevant species. For cultures on CCPP diagnostic medium, colonies were identified by their characteristic appearance as described by Bashiruddin and Windsors\cite{18}.

\textbf{Results}

\textbf{Clinical and gross pathological features}

In the 123 herds visited, 315 goats were identified to have clinical signs of the disease, which included pyrexia (41-42.0°C), dullness, dyspnoea, abdominal respiration and coughing. Severely affected animals exhibited abduction of fore legs, extension of the neck and reluctance to move. Mucopurulent nasal discharge and stringy salivation were encountered in acutely affected goats while chronic cases showed unthriftiness and occasional coughing. Out of 74 goats that were examined pathologically, 60 had lesions in the thoracic cavity and the lungs, with 47 having unilateral affection whereas, 13 were bilaterally affected. The characteristic necropsy features were presence of excess straw-
coloured fluid in the pleural cavity; varying degrees of lung enlargement, consolidation and hepatization; presence of fibrinous exudate on the lung surfaces and distended interlobular septa in some animals. Fibrinous adhesions between the visceral and parietal pleura were evident in 14 cases. The mediastinal and bronchial lymph nodes were enlarged and oedematous and sequestrum-like lesions were observed in four lungs.

Serological studies
A total of 1,927 caprine serum samples were screened for evidence of *M. capripneumoniae* using the antibody detection system of LAT whereas, 226 serum samples collected from goats in Gairo division of Kilosa district were also screened using the antigen based LAT. As shown in Table 1, the overall seropositivity based on the antibody detection system was 53%. For the 226 sera that were screened using the two LAT systems, it was found out that the antigen based LAT system detected more positive cases (95%) than the antibody based system (74.6%) and the difference was significant (p<0.01).

Bacteriological examination
Of the 74 lung samples that were subjected to culture, only 18 were positive for *M. capripneumoniae* whereas, 12 out 35 pleural fluid samples and 6 out of 29 lymph nodes also yielded *M. capripneumoniae*. Three pleural fluid samples collected from goats in Kilosa yielded *M. mycoides* LC growth. No mycoplasmas were recovered from nasal swabs collected from sick and clinically normal goats. In addition, *M. ovipneumoniae* was encountered in 29 lung specimens (4 of them in same samples with *M. capripneumoniae*), eight pleural fluid samples and five mediastinal lymph nodes.

The isolation rate of *M. capripneumoniae* was higher on CCPP diagnostic medium (13 out 18 samples) than for H25P for which only 6 were positive. On CCPP diagnostic medium, there was growth of red colonies, which showed dark grains of pigmentation and red crystalline deposits when observed using a stereomicroscope and this was more evident after seven days of incubation.

Discussion
The present study has confirmed the presence of CCPP in Iringa, Mwapwa, Kilosa and Morogoro districts in which, prior to this work, the reports were based on clinical and post-mortem features only. Therefore, the results of this study show that the disease is probably increasingly becoming more widespread and endemic in Tanzania. The endemicity and degree of spread of the disease are attributable to the lack of disease control programmes; poor animal health service delivery in the rural areas; uncontrolled animal movements and use of antimicrobials by farmers that often is associated with under-dosing and drug abuse. For instance, in this study, it was apparent that most goat owners had used antibiotics before farm visits.

Bacteriological evaluation revealed few specimens (18) that were positive to *M. capripneumoniae* despite the number of animals having typical post-mortem lesions of CCPP. The low recovery rate of *M. capripneumoniae* from samples may be attributed to its fastidiousness and easiness of being overgrown by other bacteria and fungi. Indeed, bacterial contaminants (in 17 lung samples) and *M. ovipneumoniae* (in 29 lung samples) were encountered in this study and these may have inhibited the growth of
M. capripneumoniae. However, it is also possible that the frequent use of antibiotics by farmers as observed in the study areas might have contributed to the low level of isolation of M. capripneumoniae since antimicrobial treatment significantly lowers recovery rates.

The type of media used for mycoplasma isolation might have also influenced the recovery rate of M. capripneumoniae with the CCPP diagnostic medium showing superior performance than H25P medium. It was also evident that the CCPP diagnostic medium did not support exuberant bacterial and fungal growth compared to H25P medium even after seven days of incubation. The results, thus, indicate that the CCPP diagnostic medium may be more suitable for field investigation of CCPP-suspected outbreaks in countries with limited diagnostic facilities. However, more field samples are required to validate the performance of the medium.

Demonstration of antibodies against M. capripneumoniae in the few (8) sheep sera has also been reported elsewhere. Although often sheep are believed to be refractory to infection with M. capripneumoniae, the occurrence of outbreaks of pleuropneumonia in sheep from which M. capripneumoniae was isolated probably indicates that the pathogen can successfully establish and cause a disease in these animals. This suggests a possible role of sheep in the epidemiology of the disease especially where they graze together with CCPP-infected goats. However, it is possible that sero-conversion in sheep may be due to exposure of the animals to other members of M. mycoides cluster such as M. capri and M. mycoides LC which cause pleuropneumonia in sheep and show serological cross-reactions with M. capripneumoniae. Given these contrasting observations, it is important to carry out further studies to establish whether sheep can develop an overt disease and whether they have some role in the epidemiology of CCPP.

In conclusion, this study has confirmed the presence of CCPP in Iringa, Mpwapwa, Kilosa and Morogoro districts thus indicating the disease is now more widespread in Tanzania and has now reached an endemic status that is reflected by continued occurrence of sporadic outbreaks. The outbreaks are probably triggered by stress related to movements of chronically affected animals and in situations where the animals are shifted to non-endemic areas. Therefore, in order to sustain the contribution of goats to rural livelihood, there is a need for the national veterinary authority to devise a national strategy for the control of the disease.

Acknowledgements

The implementation of this project was made possible with the financial support of the International Foundation for Science (IFS) to L.J.M. Kusiluka for which we are very grateful. We acknowledge the kind donations made by Dr. John March, Moredun Research Institute, UK for the reagents for antigen detection latex agglutination test and Mycoplasma Experience, Surrey, UK for donation of the CCPP diagnostic medium. We gratefully appreciate the technical support of Messrs Andrea Cosmas (deceased), Ally Kitime and Philemon Mkuchu for assistance in the laboratory work. We thank the District Veterinary Officers and local livestock extension officers for furnishing us with information on CCPP outbreaks and the livestock keepers for
allowing us to carry out the study on their animals.

References


Received for publication on 23rd June, 2006.
MOLECULAR ASSESSMENT OF AFRICAN SWINE FEVER IN NORTH- CENTRAL NIGERIA

1O.A.Owolodun, 1B.Yakubu, 1J.F. Antiabong, 1O.K. Adefalujo, 1M.E. Ogedengbe, 1E.T. Obisakin and 1D.Shamaki

1Department of Biochemistry and Applied Molecular Biology, National Veterinary Research Institute, Vom, Plateau State, Nigeria

EVALUATION MOLECULAIRE DE LA PESTE PORCINE AFRICAINE DANS LA PARTIE CENTRALE DU NORD DU NIGERIA

Résumé

Des échantillons de tissu prélevés des ganglions lymphatiques viscéraux, du foie, de la rate et des reins étaient collectés des porcs malades et apparentement en bonne santé sur divers étals d’abattoirs et dans différentes exploitations porcines locales de 3 États voisins au nord du Nigeria, puis examinés pour détecter l’ADN du virus de la peste porcine africaine (PPA). La réaction en chaîne par polymérase a été appliquée sur 266 échantillons collectés dans les États du Plateau, de Benue et de Kaduna. Cent trente-cinq des échantillons examinés étaient déclarés positifs après une amplification réussie d’un fragment de gène 278bp issu de tissus, à l’aide des amorces de diagnostic tel que recommandé par le Manuel de l’OIE sur les normes pour les tests de diagnostic et les vaccins. Les amorces PPA1 et PPA2, conçues pour le gène VP72, une partie de gène conservée dans le génome du virus de PPA, sont destinées à l’amplification spécifique et à la détection de l’ADN du virus PPA.

L’ADN du virus a été détecté à divers taux. Les États du Plateau et de Kaduna avaient les taux les plus élevés même chez les porcs en bonne santé qui n’avaient aucun signe clinique de PPA, ce qui montre la forte endémicité de la maladie dans ces États. L’État de Benue était le moins touché. Selon la présente étude, il s’agit de la conséquence d’une zone de marché libre commune à toutes les zones de production de porc dans le nord du Nigeria et d’un mouvement transfrontalier du virus à cause du commerce de porc et des produits de porc dans le pays.

Summary

Tissue samples consisting of visceral lymph nodes, liver, spleen and kidneys were collected from apparently healthy and ill pigs at various slaughter slabs and from local pig farms in 3 neighbouring Nigerian states and assayed for African Swine Fever (ASF) virus DNA. Polymerase chain reaction (PCR) was applied on 266 samples collected from Plateau, Benue and Kaduna states. 135 of the test samples were declared positive after successfully amplifying a 278bp gene fragment from tissues using diagnostic primers prescribed by OIE Manual of Standards for Diagnostic Tests and Vaccines. ASF1 and ASF2 primers, designed from the VP72 gene, a conserved gene region in the ASF virus genome, are designed for specific amplification and detection of ASF virus DNA.

Viral DNA was detected at varying rates; Plateau and Kaduna states had higher rates even in healthy pigs which did not present any clinical signs of ASF indicating high endemcity of the disease in these states. Benue state had the least. The study explains the implication of having a free market zone common to all northern pig producing areas in the country and trans-border movement of the virus as a result of trade in pig and pig products in Nigeria.

*Corresponding Author email: jidecoy@yahoo.com
Introduction

The African swine fever virus (ASFV) is an icosahedral linear double stranded DNA genome ranging from 170-190kb in size; it is the causative agent of African swine fever (ASF), a potentially fatal and haemorrhagic fever of domestic pigs which has become endemic in many African regions south of the Sahara. The virus presently is the only member of the Asfivirus genus of the family Asfarviridae. The virus occurs naturally in vertebrate (the giant forest hog, warthogs, bush-pigs, wild boars and domestic and feral pigs) and invertebrate hosts (Soft ticks). Viral transmission to domestic pig hosts occurs after a bite from infected soft shelled eyeless ticks of the Ornithodorous moubata complex. A cycle of transmission also occurs in which virus spread involves only a domestic pig circulation and this cycle occurs independent of soft ticks and is restricted to West and East Africa. A third cycle of transmission involves associations between all sylvatic hosts (Vertebrate and invertebrate) and domestic pigs.

After its initial description in Kenya in 1921, ASF, also referred to as 'East African swine fever', spread to Lisbon, Portugal in 1957, became endemic in Spain and Portugal, spread to other European countries and then caused outbreaks in the Caribbean and Brazil.

In the last 10 years, ASF has gained prominence by causing massive economic losses in many African countries by way of death rates and compensations payable to pig farmers. ASF was reported for the very first time in West African sub-region in 1982 in Cameroon. Before this time, it existed and caused mortality mainly in East and Southern African countries. In 1998, Nigeria and Madagascar experienced their first ASF wave and since then, it has continued to cause regular depopulation in both commercial and local piggeries. In Nigeria, the outbreak was first reported in Ogun and Lagos states; a second wave struck states of the federation namely Kaduna, Benue, Enugu, Akwa Ibom, Rivers and Delta states, this started a cascade of other outbreaks which has now resulted in an endemic state. In 2000 and 2001, another outbreak occurred in the country repeating devastating damage to numerous pig populations in a more widespread manner, this time involving states in the northern part of the country.

In North-central Nigeria, pig rearing forms an integral part of the economy, both commercial and backyard piggeries are well developed sources of subsistence. In more rural areas, individuals rely solely on proceeds from whole pig and pork sales in their local communities for their upkeep.

Presently, there is no known vaccine against the disease and this situation provides a favourable condition for continuous spread of the virus. This is particularly true for less developed countries where biosecurity and zoo-sanitary measures are less stringently adhered to. Inadequate diagnostic facilities and laxity of delegated personnel are also contributory factors to the unabating spread.

In other regions of Africa and Europe where a complete sylvatic cycle occurs, the mode of viral transmission aids in the maintenance and circulation of the virus. ASFV is transmitted trans-ovarially and trans-stadially in soft shelled eyeless tamps, Ornithodorous moubata and O. erraticus. The widespread presence of the invertebrate vector and their affinity for Suid hosts is another contributing factor. Trans-stadial and trans-ovarial means of transmission places domestic pigs and wild
pigs at a high risk of infection, this is because progeny of adult infected ticks are hatched with infections and each bite releases viruses into the blood stream of potential hosts setting the pace for new infections. In East and southern Africa, *O.moubata* and argasid ticks are found in warthog burrows and in domestic pig pens. Up till this time, the presence of soft ticks is yet to be widespread in the West African sub-region excluding invertebrate hosts in the transmission of ASF, although Omithodorous ticks have been reported in Senegal\(^2\); leaving pig to pig contact and contamination by pork products and formites as the main sources of infection.

The study described below was carried out to determine the effects of having a common trade zone in a country where ASF is enzootic, the extent of trans-boundary spread in 3 selected Nigerian states and to investigate the natural status of ASF in Northern Nigeria.

**Materials and methods**

*Samples used in this study*

All samples used in this study were tissues and organ samples collected from clinically ill pigs, pigs with inapparent infections and apparently healthy pigs. Historically, ASF in Nigeria and the West African region presented with very high morbidity, pathognomonic signs and marked scales of mortality; in recent outbreaks death without premonitory signs and lack of clinical signs accompany infections. Clinical signs of the disease are only obviously seen on post mortem examination. North-central Nigeria is known for large pig production while the far north keeps less, due to the religious inclination of the area. Plateau, Kaduna and Benue states were target areas for sampling. In Plateau, Jos north local government area (LGA) abattoir, Jos south and Ryom local governments were routinely visited; individual homesteads that kept pigs were also visited for organ tissues. In Benue state, Makurdi and Gboko LGAs apparently have the densest pig populations in the state, were visited for samples. In Kaduna state, the Katsit pig market located in Zango-kataf LGA, obviously the largest pig market in the country, holds every Thursday and also houses a slaughter slab nearby was chosen as a collection site in the state. Other parts of the state visited are Kafanchan in Jemma LGA and Zonkwa also in Zango-kataf LGA.

In all areas visited, samples were randomly collected irrespective of health status of the pigs. In Plateau state, 151 samples were gathered, 52 in Benue and 63 in Kaduna state. This formed a total of 266 tissue samples in all.

Tissue processing and DNA amplification

Organ samples after collection were transported on ice to the laboratory and stored at -70°C until they were processed. 0.5g of tissue sample was macerated in ceramic mortars and suspended in TE buffer pH 7.4. Viral nucleic acids were extracted and eluted in 30μl of nuclease-free water (Promega\(^®\)) according to protocols previously described (13) and used as template for DNA amplification. Successful DNA amplification was carried out using 2μl of extracted DNA with ASF diagnostic primers as prescribed (OIE Manual of Standards for Diagnostic Tests and Vaccines, 2000) which amplify a 278bp product. ASF1 (5' ATG GAT ACC GAG GGA ATA GC 3') and ASF2 (5' CTT ACC GAT GAA AAT GAT ACC 3') that bind to the central region located within the VP72 gene (OIE
Manual of Standards for Diagnostic Tests and Vaccines, 2000), in the presence of 200µM dNTPs (Promega®), 10pmol of each primer (Inqaba Biotech®), 5.0U of Taq DNA polymerase (Roche®) and PCR buffer (1X;10mM Tris-HCl pH 8.8, 1.5mM MgCl2, 50mM KCl, 0.1% Triton X-100). All reactions were performed in a 50µl reaction volume. The following thermal cycling conditions were used for amplification; an initial denaturation step at 94°C for 15secs, 94°C for 15secs, annealing at 62°C for 15secs, extension at 72°C for 15secs and a final extension step of 72°C for 15secs to carry on and complete strand synthesis. All PCR amplifications were carried out using a 96-well ABsystem 9700 thermal cycler.

Electrophoresis

All products of amplification were run electrophoretically on 1.5% agarose gel following ethidium bromide staining in a horizontal tank (Biorad®) electrophoresis assembly and the resulting products sized against a 100bp molecular weight ladder (Promega®). Visualization and detection of fractionated PCR fragments was facilitated in a P4 Polaroid land camera with a UV transilluminator.

Results

In this study a total of 266 samples were investigated by nucleic acid amplification for the presence of ASF genomic DNA in clinical tissues. Positive samples were recognized by the presence of clear and distinct bands 278bp in size (Fig 1); negative samples however presented no bands at all, as expected. Samples collected from each state did not carry equal number as the number collected depended on the availability at any given time. The highest number of samples was collected from Plateau state due to the volume of trade in pigs and pork and the proximity of the abattoir to the laboratory. Benue state recorded the lowest because the slaughtering of pigs is not centralized, most communities have a slaughtering point each and there are no fixed days for slaughter; therefore sampling of such areas becomes cumbersome exercise. In Jos Plateau, slaughtering takes place once a week so attention is drawn to such days and proper arrangements are made to cover every process. In the Katsit pig market slaughter slab, slaughter and pork sales are done on LGA approved market days only, therefore, fore knowledge of slaughter day makes proper sample collection possible without foregoing any samples; it also makes it possible to keep track of the disease for surveillance purposes.

Analysis and interpretation of results showed the following banding patterns of the samples assayed: In Plateau state, 76 of the samples produced diagnostic bands when estimated against a standard 100bp molecular weight marker and this was sufficient to confirm ASF. The remaining 75 did not amplify ASF DNA. In neighbouring Katsit, Zango-kataf, 44 of the abattoir samples were confirmed positive for ASF and 19 negative. Benue state which had fewer samples produced a low positive ratio; 15 of a total number of 52 were positive and 37 samples (greater than 50%) were negative.

Alternative laboratory diagnostic methods were not performed on the specimens; this is so because samples were not collected in methods suitable for viral isolation, blood could not be collected for ELISA or other forms of serology because storage conditions were not suitable enough.
ELISA as a form of diagnosis was also not inexpensive; its kits were not available at the particular period of studies.

Positive control for this study was a characterized 1998 Nigerian ASF virus isolate received from Exotic Disease Department, Ondersteepoort Veterinary Institute, South Africa and was positive at both 2µl and 1µl in 25µl reaction mix. Diagnostic band of the positive samples all corresponded to the single band of the positive control (278bp). Negative controls of either master mix only or master mix with nuclease free water, at all reactions were negative; removing possibility of false positive results.

Discussion

The aim of this study is to clarify and ascertain the status of ASF in pigs of North-central Nigeria, this region being a major and reliable pig and pork products producing area. In doing this, PCR analysis of outbreak and unsuspected samples in different parts of Nigeria and at different time intervals were carried out in this work. This approach issues more advantages over the older methods of diagnoses such as speed, specificity and sensitivity. The presence of ASFV DNA was detectable by the amplification of a conserved region of the virus genome specific for the virus. PCR technique for the confirmation of viral DNA was sensitive, specific and rapid; making the technique a method of choice for antigen detection and for confirmation of diagnosis. Genotypic viral characterization was also projected for these outbreak field strains but could not be carried out along with this study. The results shown in this study (Table 1), adds further to a previous study proving the endemicity of ASF in Nigeria.

In Plateau state alone, 151 field samples were sourced from different points around Jos metropolis. Of the 76 positive samples recorded, 56 were collected from clinically ill pigs which presented with clinical signs of ASF during various outbreaks, although some of the samples were from convalescent survivors. The remaining 20 samples were from apparently healthy pigs that did not possess any obvious clinical signs of the disease on post-mortem examination. Inapparent infections are probably now a feature of ASF in pig populations in the country which hitherto, was not a form of the infection. This form of

<table>
<thead>
<tr>
<th>Table 1. Summary of Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>State</strong></td>
</tr>
<tr>
<td>Plateau</td>
</tr>
<tr>
<td>Kaduna</td>
</tr>
<tr>
<td>Benue</td>
</tr>
</tbody>
</table>
infection may be deceptive if post-mortem signs and lesions were to be used in the tentative diagnosis of ASF especially in less developed areas where laboratory facilities are unavailable or not readily available and when time or speed of result delivery is of the essence. Percentage positivity in Plateau state is 50.33% and percentage negative, 49.66% signifying production dangers ahead.

In Kaduna south, more samples were positive. The status of the disease in this area is more precise because there was no officially reported outbreak and the samples were blindly picked at slaughter indicating a natural condition of the affected pigs. This situation may be aggravated when small outbreaks in rural areas go unnoticed and unannounced to the state veterinary services for action. In any case, these results are alarming because the current situation shows a variation in the epidemiology of ASF nowadays. Historically, ASF in Nigeria was known to occur in periodical waves, infecting whole herds of swine and causing very high mortality in affected pigs and leaving very few survivors, usually the very young. The results derived from samples assayed from Benue state are at a slight variance from the other 2 North-central states, out of 52 collected tissue samples, only 15 were declared positive. The remaining 37 were negative. At the time of sampling Benue state, there was no reported outbreak in the state. Reports from state veterinary personnel revealed that spontaneous deaths were reported occasionally and post-mortem lesions that were observed pointed to ASF infections. Although only 2 LGAs were sampled in the state, the data generated is still very significant because pig farming and production remains more predominant in these areas.

These results and data presented here are representative of North-central region because these areas form the hub of the pig industry in the entire country. One interesting angle to this conclusion is the fact that all 3 states are very close to each other geographically; Kaduna and Plateau states share a common border but Benue state is separated from them by Nasarawa state. Due to the close proximity of the states to each other, transboundary pig movement is high and this encourages the spread of ASF virus among the states sampled. Nasarawa state which lies in between is free of ASF because pig farming is negligible; the few pig farming foci are therefore, yet to be infected. The relationship between Plateau and Kaduna boundaries are more extensive and interstate trade, much higher including the national pig and pork trade.

The percentage positive in the states mentioned above is quite high and relatively similar, the reason attributable to very similar poor husbandry systems and the volume of trade between. The Katsit pig market located in Kafanchan, Kaduna state, represents a central pig market common to all states. On a weekly basis, pig farmers and sellers converge here for jumbo sales and the popularity of this market attract clientele from far. Presently, the market remains the only inter-state pig market in Northern Nigeria. The import of this centralized trade effect plays an important role in the epidemiology of the disease. In the prevailing circumstances, control of virus spread may be difficult or impossible especially when during outbreaks clients visit numerous farm sites in a bid to purchase pigs, a round trip visitation of 'clean' and infected farms adds to rapid virus spread within a locality, this trend may not be
unconnected to the similar proportion of virus circulation in these neighbouring states. Trade between Benue state and the central pig market is less remarkable and may explain the low incidence rate in domestic pigs. Pork and pork products are a delicacy here, therefore consumption rate high; the very long distance between Makurdi, Gboko and the central market may also be a major factor why the trade between is less robust. The North-central region was chosen for this study due to their closeness to each other and the interstate trade relationship with a view to determining time of outbreaks, tracing of direction of spread of outbreaks and the extent of the outbreak. The results therefore indicate a unique pattern in disease presence and spread of ASF in North-central Nigeria.

We therefore conclude that the proximity of the states and the common porous boundary shared facilitate easy spread of the disease; the existence of a common market encourages the maintenance of the virus in circulation, it also facilitates transfer of infection from state to state.

The overall effect of this is the broader circulation of virus to other regions of the country especially the southern part because pig traders who converge in Katsit market, ship purchased pigs to other abattoirs and slaughter slabs in these areas. In the wake of this trans-regional trade, is the subtle deposition of virus along routes of trade and travel thereby propagating infections in otherwise 'clean' areas.

Viruses which have been recovered from the field would subsequently be characterized, this is necessary to clarify the various genotypes and possibly identify viral variants that are in circulation in Nigerian pigs.

Acknowledgement

Authors wish to thank the Executive Director National Veterinary Research Institute, Vom, Dr. (Mrs) L.H. Lombin for permission to publish this work. We also thank personnel of the ministry of Agriculture of Plateau, Benue and Kaduna states for assistance rendered during field visits and sample collection.

References


Received for publication on 19th January, 2007.
ETUDE DES LESIONS RENCONTREES SUR DES CARCASSES DE PETITS RUMINANTS A L'ABATTOIR DE TOGLEKOPE A LOME AU TOGO

A. E. Kulo¹ et K. Seme¹

¹ Ecole Supérieure d'Agronomie, Université de Lomé, B.P. 1515, Lomé, Togo

Summary

For 5 months, from April to August 2006, 9855 carcasses of sheep and 4398 the caprine ones and their meat offals are examined at the slaughter-house of Togblekopé in Lome (Togo) under the usual conditions of inspection. The results of indexed lesions and the seizures are divided into parasitic, infectious and physiopathological lesions. On the 755 seizures of liver, there are 462 seizures for various or parasitic abscesses. The 552 seizures all of intestines are related with the presence of parasitic nodules. On the 277 seizures of lungs there are 12 suspicions of tuberculosis, 101 of parasitoses, 96 cases of pneumopathies, and 68 due to various abscesses.

The suspected lesions of tuberculosis are very rare (0,15 and 0,07%) respectively in the sheep and caprine. The tuberculosis of the small ruminants at this level of prevalence does not seem endemic. But the fact that the 2/3 of the lesions (12 cases) are localised at the lungs and the last 1/3 (6 seized cases) on the udder suggest that epidemiological and medical risks are important. The seizures for parasitic causes are made for loathing whereas those for suspicion of tuberculosis are made because of the sanitary risk.

Key words : Meat hygene, lesions, slaughtering, small ruminants, Togo.

Résumé

Pendant 5 mois, d'avril à août 2006, 9855 carcasses d'ovins et 4398 carcasses de caprins et leurs abats ont été examinés à l'abattoir de Togblekopé à Lomé (Togo) dans les conditions habituelles d'inspection. Les lésions répertoriées et les saisies sont réparties en lésions parasitaires, infectieuses et physiopathologiques. Sur les 755 saisies de foie, il y a 462 saisies pour abcès divers ou parasitaires. Les 552 saisies d'intestins sont toutes consécutives à la présence de nodules parasitaires. Sur les 277 saisies de poumons, il y a 12 suspicions de tuberculose, 101 de parasitoses, 96 de pneumopathies et 68 dues à des abcès divers.

Les lésions suspectées de tuberculose sont très rares (0,15 et 0,07%) respectivement chez les ovins et caprins. La tuberculose des petits ruminants à ce niveau de prévalence ne semble pas endémique. Mais le fait que les 2/3 des lésions (12 cas) soient localisées au niveau pulmonaire et le dernier 1/3 (6 cas saisie) au niveau mammaire indique des risques épidémiologiques et sanitaires importants. Les saisies pour causes parasitaires sont faites pour répugnance alors que celles pour suspicion de tuberculose le sont pour risque sanitaire.

Mots-clés : Hygiène de viande, lésions, abattage, Petits ruminants, Togo.
Introduction


Matériel et méthode

Matériel

Situé dans la banlieue nord à 6 Km de la mairie de Lomé, l’abattoir des petits ruminants de Togblékopé est un établissement administratif de prestation de services. Il s’agit d’un hangar couvrant une aire d’abattage bétonnée et équipée de barres et de crochets pour suspendre les carcasses après habillage pour l’inspection vétérinaire. Un puits situé à 20 mètres environ du hangar sert de source d’eau. Cette structure très peu équipée répond plus aux critères d’une tuerie qu’à ceux d’un abattoir. Les bouchers font abattre leurs animaux et récupèrent les carcasses après inspection vétérinaire pour vendre la viande sur différents marchés des quartiers de la ville de Lomé. Ils paient des taxes cumulées d’abattage et d’inspection. Deux espèces animales, ovine et caprine, sont abattues dans cet établissement.

Les animaux


Technique d’inspection

L’inspection des carcasses est faite par une équipe de l’Ecole Supérieure d’Agronomie de l’Université de Lomé associée aux services d’inspections vétérinaires en poste à cet abattoir sur la base d’un examen direct des différents organes. Des incisions sont réalisées sur des zones anatomiques déterminées suivant les règles classiques d’inspection de viande. Les réservoirs digestifs sont ouverts et examinés en dehors de l’aire d’abattage. La cailllette est immédiatement ouverte et vidée de son contenu.
Tableau I : Effectif des différentes saisies par mois

<table>
<thead>
<tr>
<th>Espèce animale</th>
<th>Organes</th>
<th>Avril</th>
<th>Mai</th>
<th>Juin</th>
<th>Juillet</th>
<th>Août</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ovins</td>
<td>Poumon</td>
<td>34</td>
<td>37</td>
<td>42</td>
<td>39</td>
<td>56</td>
<td>208</td>
</tr>
<tr>
<td></td>
<td>Foie</td>
<td>114</td>
<td>103</td>
<td>121</td>
<td>119</td>
<td>129</td>
<td>586</td>
</tr>
<tr>
<td></td>
<td>Portions d’intestin</td>
<td>62</td>
<td>91</td>
<td>68</td>
<td>79</td>
<td>78</td>
<td>378</td>
</tr>
<tr>
<td></td>
<td>Autres organes</td>
<td>10</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>15</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>(rate, rein, rumen)</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Caprins</td>
<td>Poumon</td>
<td>12</td>
<td>18</td>
<td>12</td>
<td>11</td>
<td>16</td>
<td>69</td>
</tr>
<tr>
<td></td>
<td>Foie</td>
<td>49</td>
<td>44</td>
<td>15</td>
<td>21</td>
<td>40</td>
<td>169</td>
</tr>
<tr>
<td></td>
<td>Intestin</td>
<td>36</td>
<td>30</td>
<td>41</td>
<td>20</td>
<td>47</td>
<td>174</td>
</tr>
<tr>
<td></td>
<td>Autres organes</td>
<td>13</td>
<td>6</td>
<td>9</td>
<td>4</td>
<td>6</td>
<td>38</td>
</tr>
</tbody>
</table>

Les lésions observées sont enregistrées suivant le type de lésion et sa localisation. Ces lésions sont ensuite regroupées en 3 catégories : lésions d’origine parasitaire, infectieuses et physiopathologiques.
Dans les lésions parasitaires, on trouve des lésions dues à des :
- Trématodes : lésions de distomatose dans le foie ou présence de paramphistomes dans le rumen.
- Cestodes : présence de kystes flasques de cysticerque de *Taenia hydatigena* et des kystes sous pression d’échinococcose.
- Nématodes : nodules intestinaux assimilés aux larves de nématodes en évolution ou en hypobiose (*Oesophagostomum spp.*) des éléments vermíneux qui sont des nématodes (*Haemonchus spp.*) ou des points d’ulcération qui sont assimilés aux points de fixation des même parasites. Il est alors noté la présence de nodules sur l’intestin grêle et / ou le gros intestin pour *Oesophagostomum spp.*

Les lésions infectieuses regroupent des lésions suspectes de tuberculose ou des lésions inflammatoires atypiques à évolution plus ou moins avancée comme desabcès divers ou des pneumopathies.

Les lésions physiopathologiques regroupent des lésions relatives à des réactions de l’organisme comme des cirrhoses hépatiques ou calculs rénaux.

Les résultats donnés sont calculés par type de lésion et par espèce animale.

**Traitement des données**
Le traitement des données obtenues a consisté en la description statistique par le calcul des moyennes et des pourcentages par type de lésion et par espèce animale à l’aide de STAT-ITCF4.

**Résultats**

1. *Les effectifs abattus*
Sur les 9855 ovin et 4398 caprins abattus et inspectés au cours des 5 mois, on compte mensuellement 1838 à 2074 ovin et 779 à 978 Caprins (Figure 1). La répartition des abattages est régulière sur tous les mois avec les mêmes proportions (38 – 45 %) de caprins par rapport aux ovin.

2. *Les saisies*
Les saisies récapitulées au tableau I ont généralement été des saisies partielles. Le foie, les intestins et les poumons ont été les organes les plus fréquemment saisis dans les deux espèces. Seulement 5 saisies totales ont été réalisées en 5 mois.
Sur les 586 foies d’ovins et 169 foies de caprins saisis, il y a eu au total 462 saisies pour abcès divers ou parasitaires. Les saisies d’intestins (552) ont été toutes consécutives à la présence de nodules parasitaires. Sur les 277 saisies de poumons, il y a eu 12 suspicions de tuberculose, 68 d’abcès divers, 101 de parasitoses et 96 cas de pneumopathies (Tableau 1). Les saisies pour causes parasitaires l’ont été pour répugnance alors que celles pour suspicion de tuberculose ont été pour risque sanitaire.

3. Les lésions parasitaires
Les cysticercques sont localisés surtout sur les organes abdominaux (foie / intestin avec 74,7%) et sur les poumons (25,4%). Ces cysticercues sont les lésions les plus rencontrées dans les deux espèces animales abattues avec 3,24 % de prévalence chez les ovins et 1,18 % chez
les caprins. Tous les kystes d'échinococque observés sont incrustés dans le foie.

Les lésions à trématodes sont rares (<0,5%) sauf celles liées à Dicrocoelium spp. avec respectivement 1,12 et 1,97 % chez les ovins et caprins.

Parmi les lésions à nématodes, on trouve des nodules d'oesophagostome dans les parois intestinales, les vers nus (Haemonchus spp.) ou les ulcères de fixation de ces vers dans la caillette (Tableau II). 80% des ovins et 73, 2 % des caprins ont présenté des ulcères de la caillette.

Mais les nodules intestinaux sont repérés chez moins de 5 % des animaux (Tableau II).

4. Lésions d'origine infectieuse

Les prévalences des lésions d'origine infectieuse enregistrées ont été très faibles (<1 %) sauf les abcès divers. Toutefois, il faut noter l'importance sanitaire de la tuberculose même si les prévalences notées ont été très faibles (0,15 et 0,07%) (Tableau III). Les 2/3 de ces lésions de tuberculose sont localisées sur les poumons et le 1/3 restant sur les mamelles (Tableau V). Il s'agit de deux formes de dissémination potentielle du germe.

5. Lésions d'origine physiopathologique

Les prévalences des lésions physiopathologiques sont très faibles. (Tableau IV).

6 - Récapitulatif

Toutes les lésions ovines et caprines mélangées (199) représentées par des abcès divers sont localisées au niveau du foie (65,5%) et des poumons (34,5%).

Discussion

A Lomé, la viande de chèvre est plus appréciée que celle du mouton. De ce fait, la viande de chèvre passe le plus souvent par un circuit hors des abattoirs administratifs dans la restauration collective de rue. Cette appréciation particulière de la chèvre se rencontre également au Zimbabwe où elle joue un rôle hédoniste et surtout identitaire; elle représente un élément clé de la vie sociale, sert au paiement de la dot du futur marié ; elle est de plus traditionnellement consommée à l'occasion de fêtes et fait l'objet d'une recherche particulièrement

Tableau III : Répartition étiologique des lésions infectieuses

<table>
<thead>
<tr>
<th></th>
<th>Chez les ovins</th>
<th></th>
<th>Chez les caprins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuberculose</td>
<td>15 (0,15)</td>
<td>Pneumopathies</td>
<td>81 (0,82)</td>
</tr>
<tr>
<td>Pneumopathies</td>
<td>81 (0,82)</td>
<td>Hydropéricardite (Cowdriose)</td>
<td>6 (0,06)</td>
</tr>
<tr>
<td>Hydropéricardite (Cowdriose)</td>
<td>6 (0,06)</td>
<td>Abcès divers</td>
<td>147 (1,49)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Abcès divers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chez les caprins</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tuberculose</td>
<td>3 (0,07)</td>
<td>Pneumopathies</td>
<td>15 (0,34)</td>
</tr>
<tr>
<td>Pneumopathies</td>
<td>15 (0,34)</td>
<td>Hydropéricardite (Cowdriose)</td>
<td>22 (0,5)</td>
</tr>
<tr>
<td>Hydropéricardite (Cowdriose)</td>
<td>22 (0,5)</td>
<td>Abcès divers</td>
<td>52 (1,18)</td>
</tr>
</tbody>
</table>

( ) Pourcentage par rapport aux 9855 ovins et 4389 caprins abattus
Tableau IV : Lésions physiopathologiques

<table>
<thead>
<tr>
<th></th>
<th>Chez les ovins</th>
<th>Chez les caprins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculs rénaux</td>
<td>8 (0,08)</td>
<td></td>
</tr>
<tr>
<td>Cirrhose</td>
<td>17 (0,17)</td>
<td>6 (0,14)</td>
</tr>
</tbody>
</table>

( ) Pourcentage par rapport aux 9855 ovins et 4389 caprins abattus

Tableau V : Localisation des lésions dans toutes les espèces

<table>
<thead>
<tr>
<th></th>
<th>Tuberculose</th>
<th>Abcès divers</th>
<th>Cysticercose</th>
<th>Echinococcose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mamelles</td>
<td>6 (33,3)</td>
<td>68 (34,5)</td>
<td>101 (25,3)</td>
<td>35 (100)</td>
</tr>
<tr>
<td>Poumons</td>
<td>12 (66,6)</td>
<td>129 (65,5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foie</td>
<td>298 (74,7)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

( ) Pourcentage par rapport au nombre de lésions dans la catégorie

active à Noël². L’inspection vétérinaire se fait alors au point de restauration qui est aussi le lieu d’abattage. Ces deux raisons expliquent en partie les faibles effectifs de chèvres abattues par rapport aux moutons. L’importation de petits ruminants sur pied concerne surtout les ovins.

Les lésions parasitaires sont les plus rencontrées au cours de ces inspections de viande. Les lésions liées aux nématodes sont les plus fréquentes et elles constituent les causes essentielles de saisie d’intestin dans les deux espèces animales. Ces résultats mettent en évidence l’importance des parasitoses dans le système d’élevage extensif avec peu d’utilisation d’antiparasitaires. Des résultats similaires sont obtenus dans des études coproscopiques menées à Sokodé dans le centre du Togo sur les ovins et les caprins⁵,⁶.

Les prévalences de ces lésions parasitaires peuvent être affectées par la technique d’examen uniquement visuelle car Chartier et al (1990)⁷ montrent que chez les bovins au Zaïre, les lésions parasitaires sont de loin en dessous des charges parasitaires.

Ils précisent que les bovins hébergent des charges parasitaires moyennes et ne manifestent pas d’importantes lésions associées ; ce qui pourrait bien être le cas chez les petits ruminants. Les lésions à strongyloses pulmonaires ne sont pas rencontrées et ceci reflète leur rareté dans le milieu.

Sur le plan épidémiologique, une attention particulière devrait être portée sur la gestion des cysticerques car ils sont rejetés à la portée des chiens errants alors que ces derniers sont les hôtes définitifs de Taenia hydatigena. Il y a un véritable risque d’explosion de cette parasitose au niveau des petits ruminants vu le système d’élevage extensif dans lequel ils côtoient
quotidiennement les chiens errants. Cette gestion est plus importante pour la santé publique lorsqu'il s'agit d'échinocoques (30 cas au total). Il est donc important d'identifier le type de cestodose larvare et d'appliquer à terme une gestion plus adéquate. Quel que soit le type de cestodose larvare, une récupération et une destruction des viscères associées à une lutte contre les chiens errants pourraient être envisagées. Ceci réduira les risques d'expansion de ces parasites. Leurs prévalences doivent être beaucoup plus importantes que les chiffres obtenus dans cette étude car Chantal et al. (1994)² trouvent, à Djibouti, 0,86 % et 0,92 % de kystes hydatiques lors de l'examen des carcasses à l'abattoir et 4,45 % et 10,8 % lors d'examens de laboratoire sur 499 et 1081 carcasses respectivement de bovins et de petits ruminants.

Les paramphistomes dans le rumen et les douves dans le foie sont également causes de saisies partielles.

Dans la dicrocoeliose chez les bovins, il y a des lésions d'hépatite parenchymateuse qui fait progressivement place à une cholangite, puis à une cirrhose⁶. De ce fait, les cirrhoses classées dans les lésions physiopathologiques peuvent être liées aux douves.

Les résultats obtenus dans notre étude présentent des chiffres plus faibles que ceux obtenus par de nombreux auteurs sur des bovins⁷,⁹,¹⁰,¹¹. Les prévalences des lésions infectieuses sont très faibles. Mais si l'on met en place des analyses microbiologiques, ces prévalences peuvent être beaucoup plus élevées. C'est ce que ressortent les travaux de Niamy et al. (2001)¹² qui trouvent que 83,6 à 99 % des viandes vendues à Conakry en Guinée ne répondent pas aux normes microbiologiques européennes.

Ils estiment alors que l'amélioration de cette situation passe obligatoirement par un perfectionnement des conditions d'hygiène, d'abattage et de traitement des viandes jusqu'au consommateur. Ces mesures doivent être prises avant le consommateur qui n'établit pas toujours le lien entre une lésion donnée et une pathologie humaine comme le précise Assana et al.(2001)¹³. Les lésions de tuberculose observées sont très faibles (0,15 et 0,07%) respectivement chez les ovins et caprins contre 2,8 % observés par Igbokwe et al. (2001)¹⁴ au Nigeria dans les conditions d'inspection aux abattoirs.

Au cours de cette étude, les services vétérinaires ne prononçaient des saisies totales pour suspicion de tuberculose que dans les cas de lésions étendues ou de forme évolutive. Dans les formes stabilisées limitées à un organe, la saisie porte sur cet organe avec un examen systématique des ganglions satellites ou carrefour pour rechercher le retentissement.

La tuberculose des petits ruminants à ce niveau de prévalence ne semble pas endémique. Mais le fait que les 2/3 des lésions soient localisées au niveau pulmonaire et le dernier 1/3 au niveau mammaire indique des risques épidémiologiques et sanitaires plus importants. L'impossible traçabilité fait qu'on ne connaît pas les troupeaux d'origine des animaux à lésions de tuberculose.

Conclusion

Les résultats de cette étude ressortent qu'à la suite d'une inspection vétérinaire des viandes, les saisies sont prononcées essentiellement sur la base des lésions et / ou suspicion sans analyse de laboratoire ; d'où de faibles saisies et des risques de mettre sur le marché des viandes insalubres. Les analyses de laboratoires sont
nécessaires surtout pour limiter les risques de zoonoses comme la tuberculose. En outre, des mesures de destruction de saisies doivent être prises pour limiter des risques d'explosion épidémiologique de certaines maladies animales ou zoonotiques.

**Bibliographie**

ASSESSMENT OF HYGIENIC QUALITY OF CAMEL (Camelus dromedarius) MILK IN KHARTOUM STATE, SUDAN

E. S. Shuiep1,2, *I. E. M. El Zubeir2, O. A. O. El Owni2 and H. H. Musa1,3

1Department of Animal Production, Faculty of Veterinary Science, University of Nyaia, Nyaia. E-mail: tahirr13@yahoo.com

2Department of Dairy Production, Faculty of Animal Production, University of Khartoum, Khartoum North, Postal Code 13314, Sudan. E-mail: ibtisammohamed@hotmail.com

3College of Animal Science and Technology, Yangzhou University, Yangzhou 225009, China. E-mail: hassan_hm30@yahoo.com

EVALUATION DE LA QUALITE HYGIENIQUE DU LAIT DE DROMADAIRE (Camelus dromedarius) DANS L’ETAT DE KHARTOUM AU Soudan

Résumé

Au total, 112 échantillons de lait de dromadaire ont été collectés entre décembre 2004 et juin 2005, afin d'évaluer la qualité hygiénique du lait cru de dromadaire dans deux localités de l'État de Khartoum au Soudan. Pour ce faire, on a effectué les comptages des flores microbiologiques ci-après : le dénombrement total de bactéries, d’organismes mésophiles, de bactéries psychrophiles et coliformes, les nombres d’E. coli, de Staphylococcus spp. et de champignons. Aucune différence significative n’a été constatée en comparant les deux localités en ce qui concerne le dénombrement de bactéries, d’organismes mésophiles et de champignons. Le Nil oriental avait enregistré un nombre élevé (P=0,05) de bactéries coliformes, d’E. coli et de Staphylococcus spp. Parmi les 112 échantillons de lait de dromadaire collectés, E. coli, Staphylococcus spp. et le champignon ont été signalés dans 33 (29,5%), 46 (41%) et 32 (28,6%) des échantillons respectivement. En outre, les bactéries psychrophiles n’ont pas été aperçues au cours de l’étude, ce qui est peut-être dû au manque de matériel de refroidissement chez les communautés nomades. Même si le lait cru de dromadaire constitue l’aliment de base des pasteurs, les résultats de la présente étude ont montré que dans l’ensemble le lait cru de dromadaire est de qualité médiocre et qu’il y a une variabilité des échantillons quant à la qualité hygiénique. Toutefois, aucun cas de maladie n’a été signalé chez les pasteurs au Soudan suite à la consommation de lait cru de dromadaire.

Mots-clés : Lait de dromadaire, qualité microbiologique, Etat de Khartoum, Soudan.

Summary

A total of 112 individual camel milk samples were collected during the period from December 2004 to June 2005 to evaluate the hygienic quality of raw camel milk in two locations of Khartoum State, Sudan. To achieve this the following microbiological counts were done: total bacterial counts, mesophilic counts, psychrotrophic count, coliform counts, E. coli counts, total Staphylococcus spp. counts and yeast- mold counts. Non-significant differences were reported when comparing the two locations in total bacterial counts, mesophilic counts and yeast- mold counts. Eastern Nile scored significantly (P=0.05) high coliform counts, E. coli counts and Staphylococcus spp. counts. Of the 112 camel milk samples E. coli, Staphylococcus spp. and yeast- mold were reported in 33 (29.5%), 46 (41%) and 32 (28.6%) camel milk samples, respectively. Moreover, psychrotrophic bacteria were not reported during this study, which can be explained by the lack of cooling facilities among the nomadic communities. Despite of it is been the major stable food for the pastoralists, the overall result obtained from the current study suggested that raw camel milk is of poor quality with presence of great variability among the milk samples regarding the hygienic quality. However, no outbreak causes reported by the consumption of raw camel milk among the pastoralist in Sudan.

Keywords: Camel milk, microbiological quality, Khartoum State, Sudan.
**Introduction**

Camels (*Camelus dromedarius*) are animals with special importance for nomadic herders in Sudan, as they are milk providers, which is often the only regular food source for camel owners for a considerable period of the year. Usually most of this milk is consumed fresh.

Milk is synthesized in specialized cells of the mammary gland and is virtually sterile when secreted into the alveoli of the udder. However, raw camel milk may contain microorganisms, which are pathogenic for man. As milk leaves the udder of healthy animal, it normally contains very low number of microorganisms and further hazards stem from the adventitious contamination of raw camel milk by pathogenic bacteria from external sources from the udder like salmonella and campylobacter strains. Those strains produce many outbreak of enteritis. Pathogenic bacteria may also be present in raw camel milk as direct consequence of udder disease especially mastitis. Generally the microbial contamination in raw milk occurs from within the udder (diseases), exterior of the udder, and the surface of the milk handling equipment. Moreover, the skin of the udder, tick wounds on the teats and milker’s hand, especially if unwashed perfectly before milking or with wounds, are among the sources of contamination. Besides, the dust and flies at the milking site, especially if milk containers were left open, also the use of dirty water for milking process are among the source of contamination. Being a major constituent of nomadic diet, healthy camel milk production is considered essential to their health and welfare. However, nomads have shown very little interest to whether food and drink are good detrimental to their health, as their concern being only to have enough food. In developing communities food-borne pathogens are responsible for million of cases of infectious gastrointestinal diseases each year. Food-borne pathogens are the cause of major public health problems worldwide. To date, around 250 different food-borne diseases have been described, and bacteria are the causative agents of two thirds of these disease outbreaks. Investigations showed that camel milk is highly contaminated when milked under nomadic conditions.

The present study aims to determine raw camel milk hygienic quality at udder level, through the assessment of counts of total microbial flora (aerobic plate count, mesophilic bacterial counts and psychrotrophic bacterial counts), faecal contamination flora (coliform count), potential pathogens (*E. coli* and *staphylococci spp.*) and yeast-mold counts.

**Material and methods**

**Source of samples and microbiological examination**

This study was carried out during December 2004 to June 2005. After perfectly washing the udder, approximately 20 ml of quarter milk samples (n = 112) of camel milk were collected in sterile bottles from 56 camel in two different locations (Eastern Nile and Western Omdurman) of Khartoum State, Sudan. Samples were immediately labeled, stored in icebox and transferred within 2 hours to the laboratory.

According to the procedure outlined by Houghtby et al. and the manufactures instructions, total bacterial counts, mesophilic bacterial counts and psychrotrophic bacterial counts were determined by pour plating appropriate dilution of milk samples in duplicate on plate count agar (Merck, Darmstadt, Germany). Plates were incubated at 32°C- 48 hours.
35° C - 48 hours and 7° C - 7-10 days, respectively. For the determination of the total coliform counts, Escherichia coli counts and Staphylococcus spp. counts appropriate dilution of the milk samples were spread on MacKonkey agar (Biomark, Pune, India), Violet Red bile agar (LABM, International Diagnostic Group, Bury Luncashire, U.K.) and Manitol salt agar (Oxoid, Hampshire, England), the plates were incubated at 32° C for 48 hours, respectively. Yeast-molds count was done on Yeast Extract agar (Biomark, Pune, India), after incubation at 25° C for 7 days. All counts were done in duplicates and the counting was done manually by using colony counter and reported as colony forming unit per milliliter (cfu/ml). The total number of the colonies in the selected dilution was multiplied by the reciprocal of the dilution.

Identification of the organisms

The isolates of Escherichia coli and Staphylococcus spp. were Gram stained and subjected for motility and catalase test, acid production and oxidation fermentation (OF) test were also done. Moreover, Indole test, citrate utilization, fermentation of sugars (maltose, Manitol, lactose), Methyl Red (MR), Voges-Proskaur (VP) and tube coagulase test were done as secondary confirmatory tests.

Results and discussion

The mean total bacterial count of camel milk samples collected from two locations of Khartoum State was 1.22×10^8 cfu/ml. It was found to be higher when compared to those reported previously. This high total counts mean indicates low quality of some raw camel milk. Measurement of bacterial number in milk is of interest, because they are indicators of poor milk hygiene. Because of its properties, camel milk bacteriology is relevantly different in comparing to milk from other species.

The total bacterial counts of camel milk samples collected in Eastern Nile revealed mean total count of 1.36×10^8 cfu/ml (Table 2) with non-significant differences (P= 0.05) when compared to that of camel milk samples collected from Western Omdurman (1.08×10^8). These more or less similar values might indicate that camel owners in both locations practice the same management procedure. Similarly, non-significant differences for mesophilic counts (5.02×10^7 cfu/ml and 5.27×10^7 cfu/ml) for Eastern Nile and Western Omdurman, respectively. This may also indicate similar management and practices. The mean mesophilic bacterial count of camel milk samples collected from Khartoum State was 4.86×10^6 cfu/ml.

The psychrotrophic bacteria were not reported during this study, which could be due to the lack of cooling facilities for camel owners in these two locations. Moreover, the samples were collected directly from the udder, with very low probability of contamination.

The mean coliform bacterial count of camel milk samples collected from Khartoum State was found to be 1.70×10^7 cfu/ml. This count was higher in compare to those reported previously. The camel milk samples collected from Eastern Nile showed higher coliform counts in compare to that collected from Western Omdurman (Table 2). This high coliform count in Eastern Nile may be due to that some camels are kept in farms with dairy cattle, this may be source of contamination and transmission of infections, specially mastitis, through manual milking, this supported the previous report which stated that high coliform counts are due to contamination with feecal material, improper sanitation and/or mastitis.
infection\textsuperscript{10}.

Of the 112 raw camel milk samples obtained during this study, only 33 (29\%) showed the presence of \textit{E. coli} (Table 1). The mean \textit{E. coli} counts in camel milk samples collected from Khartoum State was found to be 9.92×10\textsuperscript{6} cfu/ml. However the average \textit{E. coli} counts obtained in Eastern Nile was significantly (\textit{P} = 0.05) higher than that obtained from Western Omdurman (Table 2). This might also indicates contamination with faecal material, especially during summer because of the relatively high rate of diseases including enteritis\textsuperscript{8}. Moreover the high counts of \textit{E. coli} might be present in raw milk as a consequence of mastitis; this species is responsible for several different diseases for man of varying severity\textsuperscript{12}.

The mean \textit{Staphylococcus} \textit{spp.} counts of camel milk samples collected from Khartoum State was 3.08×10\textsuperscript{7} cfu/ml. This mean was higher than that reported in the previous reports\textsuperscript{11, 26}. The minimum and maximum values were 0 and 3.10×10\textsuperscript{7} cfu/ml, respectively (Table 2). In this study 46 (41\%) positive \textit{Staphylococcus} \textit{spp.} cases were reported (Table 1) of which 21 were in Eastern Nile and 25 were from Western Omdurman. The camel milk samples collected from Eastern Nile revealed mean \textit{Staphylococcus} \textit{spp.} count of 3.55×10\textsuperscript{7} cfu/ml, while those collected from Western Omdurman showed 2.21×10\textsuperscript{7} cfu/ml.

\textbf{Table 1:} Comparison of incidences and frequencies of microbial quality of camel milk samples collected from Eastern Nile and Western Omdurman in Khartoum State, Sudan

<table>
<thead>
<tr>
<th>Location</th>
<th>\textit{E. coli}</th>
<th>\textit{Staphylococcus} \textit{spp.}</th>
<th>Yeast- mols</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern Nile</td>
<td>18 (32.1%)</td>
<td>21 (45.7%)</td>
<td>15 (46.9%)</td>
</tr>
<tr>
<td>Omdurman</td>
<td>15 (26.8%)</td>
<td>25 (54.3%)</td>
<td>17 (53.1%)</td>
</tr>
<tr>
<td>Khartoum State</td>
<td>33 (29.5%)</td>
<td>46 (41.1%)</td>
<td>32 (28.6%)</td>
</tr>
</tbody>
</table>

\textbf{Table 2:} Raw camel milk hygienic properties in the milk samples collected from two locations in Khartoum State, Sudan

<table>
<thead>
<tr>
<th></th>
<th>\textbf{Eastern Nile}</th>
<th>\textbf{Omdurman}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Maximum</td>
</tr>
<tr>
<td>Total count (cfu/ml)</td>
<td>3.10×10\textsuperscript{7}</td>
<td>3.55×10\textsuperscript{7}</td>
</tr>
<tr>
<td>Coliform (cfu/ml)</td>
<td>0</td>
<td>2.10×10\textsuperscript{7}</td>
</tr>
<tr>
<td>\textit{E. coli} (cfu/ml)</td>
<td>0</td>
<td>1.28×10\textsuperscript{7}</td>
</tr>
<tr>
<td>\textit{Staphylococci} \textit{spp.} (cfu/ml)</td>
<td>0</td>
<td>2.80×10\textsuperscript{7}</td>
</tr>
<tr>
<td>Yeast-mold (cfu/ml)</td>
<td>0</td>
<td>2.80×10\textsuperscript{7}</td>
</tr>
</tbody>
</table>
significant differences (P= 0.05) were obtained when comparing the two locations. Pathogenic bacteria may be present in raw camel milk as direct consequence of udder infection, especially with *S. aureus*\(^{25, 31}\). *Staphylococcal mastitis* poses more direct threat to public health\(^{21, 30, 32}\), through the *staphylococcal enterotoxins*, that produced by *Staphylococcus aureus*, which is an extraordinary versatile pathogen causing a wide spectrum of mild to severe life threatening infection in human\(^{14, 19, 32}\). Moreover, the present data showed that the yeast- molds count of camel milk samples collected from Khartoum State was 2.54×104 cfu/ml, which was higher than that reported previously\(^{11, 19, 25}\). Samples collected from Eastern Nile and Western Omdurman showed significant differences (P= 0.05) when comparing the mean yeast- molds counts (2.80×105 cfu/ml and 2.28×104 cfu/ml, respectively). These differences might be due to that camel owners in Eastern Nile keep their camel in dairy farm with cattle. Moreover, keeping camel with cow in the same farms might be responsible for disease transmission. Data concerning microorganisms' isolated from fresh raw camel milk showed highly significant differences (P= 0.01) between the two locations. The poor hygienic quality of camel milk obtained during the present study indicated the lower standard of management practiced by camel owners in Khartoum State. This necessitates the increase of awareness of camel herders on the production of hygienic milk\(^{33}\). This is especially needed because of the well known nutritional and health benefits of camel milk in the nomads live\(^4, 13\).

It was noticed that the knowledge of camel owners on health risk associated with milk consumption was low as it was revealed from the questionnaire conducted during the present study (data not shown), this supported the report which stated that the lack of awareness on health risks associated with milk consumption amongst nomadic communities needs to be addressed in order to safeguard their health\(^{30}\).

The present study recommended that due to the importance of these organisms for the public health and food safety, an efficient screening for the prevalence in camel milk is urgently needed to safeguard the nomadic communities as camel milk is their main food source.

The present study was funded by the Islamic Development Bank (Jeddah) and Ministry of Higher Education and Scientific Research. The collaboration of camel herders during collection of camel milk samples is appreciated with thanks.

References


Received for publication on 29th March, 2007.
EFFETS DE LA CUISson OU DE L’EXTRUSION DU NIEBÉ (Vigna unguiculata) SUR LES PERFORMANCES DE PRODUCTION DES POULETS DE CHAIR EN FINITION

A. Teguia, V.P. Chakam* et J. Tchoumboue

Département des Productions Animales, Faculté d’Agronomie et des Sciences Agricoles (FASA), Université de Dschang, B.P. 70, Dschang, Cameroun
*E-mail: vpchakam@yahoo.fr

THE EFFECT OF COOKING OR EXTRUSION OF COWPEA (Vigna unguiculata) ON THE PRODUCTION PERFORMANCES OF FINISHER BROILERS

Summary

A total of 160 23 days old males Hubbard broilers chicks, were used to evaluate the effect of treatment of cowpea (Vigna unguiculata) on feed consumption, growth, feed conversion ratio, feed conversion efficiency, carcass characteristics and creatinine level in serum of finisher broilers. The experimental rations contained 0% of cowpea (R0), 15% of raw (R1), cooked (R2) or extruded (R3) cowpea. The R2 ration containing cooked cowpea was the most consumed (P<0.01) compared to other rations. The weight gain and feed conversion ratio recorded for the R2 group were not different from that of the control birds (R0). There was no significant difference between R0, R1 and R2 rations for the feed conversion efficiency during the experimental period. The R3 ration induced the lowest carcass yield and the higher percentage of liver, gizzard, heart and abdominal fat while all the other rations were not different for these parameters. No significant difference was detected among treatment groups for creatinine level in the fowl’s serum. Cooking at the temperature of about 115°C under a pressure of 1517Pa may be the best treatment method of cowpea grains as broiler feed.

Keywords : Cowpea, Cooking, Extrusion, Broiler, Production performances.

Résumé

Des poussins de chair mâles de souche Hubbard (160 au total) âgés de 23 jours ont été utilisés pour tester l’effet du type de traitement des grains de niébé (Vigna unguiculata) sur la consommation alimentaire, la croissance, l’indice de consommation, le coût de production, les caractéristiques de la carcasse et le taux de la créatinine sérique chez des poulets de chair en finition. Quatre rations R0, R1, R2 et R3 contenant respectivement 0% de niébé, 15% de niébé cru, cuit ou extrudé ont été utilisées. Il ressort que la ration R2 a été la plus consommée comparée à toutes les autres. Le gain de poids et l’indice de consommation enregistrés dans le lot R2 n’ont pas été différents (P>0,05) de ceux du lot témoin(R0). Avec R3, on a obtenu le rendement carcase le plus faible et les proportions de foie, de gésier, de cœur et de graisses abdominales les plus élevées. Il n’y a pas eu de différence significative entre les différents traitements pour la concentration de la créatinine dans le sérum sanguin. La cuisson à une température d’environ 115°C sous une pression de 1517Pa pendant 3 minutes est le meilleur traitement des grains de niébé destinées à l’alimentation des poulets de chair.

Mots-clés : Niébé, cuisson, extrusion, poulets de chair, performances de production.
Introduction

L'un des problèmes majeurs de l'aviculture moderne en Afrique subsaharienne est celui de l'utilisation des aliments de moins bonne qualité que dans les pays industrialisés. Cette situation s'est aggravée avec d'une part, l'interdiction des farines animales dans l'aliment du bétail\textsuperscript{1,2,3,4} et d'autre part, le renchérissement de tourteau de soja sur le marché mondial du fait de la forte demande chinoise et des pays émergents d'Asie. Robinson et Singh\textsuperscript{5} estiment d'ailleurs que les sources traditionnelles de protéines pour volailles vont non seulement devenir plus chères, mais vont se raréfier, d'où la nécessité de rechercher des solutions de réchange. Le niébé est une légumineuse à graines riche en protéine brute (24\%)\textsuperscript{6,7}. Toutefois, Les graines crues de niébé contiennent des facteurs antinutritionnels comme l'antitrypsine, les lectines, les phytates, les tannins, les oligosaccharides, etc. qui ont un effet dépressif sur la consommation et la croissance des poulets\textsuperscript{7,8,9,10,11,12,13}. Différents auteurs ont suggéré le traitement à la chaleur des graines comme moyen de détoxicification pour améliorer les performances des poulets\textsuperscript{14,15}. Des travaux de Mbakop\textsuperscript{16} et de Chakam\textsuperscript{17} sur l'introduction du niébé bouilli et toasté respectivement dans les rations démarrage et finition des poulets de chair, et de la revue faite par Téguia et Beynen\textsuperscript{15} sur l'utilisation des sources alternatives de protéines végétales dans l'alimentation des poulets de chair au Cameroun, il ressort que les meilleures conditions de traitement des légumineuses à graines en général et du niébé en particulier ne sont pas bien maîtrisées, ce qui limite les performances des poulets.

L'objectif de la présente étude est d'évaluer l'effet de la cuisson ou de l'extrusion des graines de niébé sur les performances de production des poulets de chair mâles en finition.

Matériaux et méthodes

Traitement des graines

Les graines de niébé (\textit{Vigna unguiculata}) achetées sur le marché local à l'état sec ont été utilisées crues, cuites ou extrudées. Pour la cuisson, les graines de niébé ont été versées dans une cocotte minute contenant de l'eau bouillante. La cocotte fermée, a été portée à ébullition et maintenue à une température de 115°C sous une pression de 1517Pa pendant 3 minutes. Les graines bouillies ont été égouttées et séchées au soleil pendant 7 jours jusqu'à un taux d'humidité d'environ 10%.

Pour l'extrusion, les graines de niébé ont été trempées dans de l'eau froide pendant 12h, puis séchées au soleil pendant 7 jours. Les graines séchées ont été soumises à une extrusion humide à 100°C pendant 30 secondes à l'aide d'un extrudeur monovis avec pré-broyage. Le produit obtenu avait un taux d'humidité d'environ 9%.

Le niébé cru, cuit ou extrudé a été également concassé avant son incorporation dans les différentes rations. Des échantillons ont été prélevés pour l'analyse de leur composition chimique\textsuperscript{9}.

Quatre rations expérimentales désignées R0, R1, R2, R3 ont été utilisées. La ration témoin R0 (control) ne contenait pas de niébé. Les rations R1, R2, R3 contenaient respectivement 15\% de niébé cru, cuit ou extrudé. La composition (\%), les caractéristiques chimiques calculées et le coût de production des rations expérimentales sont consignés dans le tableau 1.
**Animaux d'expérimentation et leur conduite**

Cent soixante (160) poussins de chair mâles, de souche Hubbard, âgés de 23 jours et pesant en moyenne 644,8g, ont été utilisés. Ces poussins démarrés sur litière, avec un aliment conventionnel contenant 21,9% de protéine brute, 2990,8Kcal/kg d'énergie métabolisable, 1% de calcium et 0,4% de phosphore, ont été vaccinés contre la maladie de Newcastle et la bronchite infectieuse à 7 jours d'âge avec rappel au 23ème jour et contre la maladie de Gumboro à 10 jours d'âge. Un anti-stress "Aliseryl W.S®" leur a été servi dans l'eau de boisson pendant les 3 premiers jours, avant et après les vaccinations, pendant la période de transfert au bâtiment finition et de transition de l'aliment démarrage à l'aliment finition. Tous les poussins ont été protégés contre

**Tableau 1 : Composition, caractéristiques chimiques calculées et coût de production des différentes rations expérimentales**

<table>
<thead>
<tr>
<th>Ingrédients (Kg)</th>
<th>$R_0$</th>
<th>$R_1$</th>
<th>$R_2$</th>
<th>$R_3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mais</td>
<td>62</td>
<td>53</td>
<td>53</td>
<td>53</td>
</tr>
<tr>
<td>Remoulage</td>
<td>8</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Tourteau de soja</td>
<td>8</td>
<td>10</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Tourteau de coton</td>
<td>5,5</td>
<td>4,5</td>
<td>3,5</td>
<td>4,5</td>
</tr>
<tr>
<td>Concentré 10% *</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Niébé</td>
<td>0</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Farine de poisson</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Farine d’os</td>
<td>1,25</td>
<td>1,25</td>
<td>1,25</td>
<td>1,25</td>
</tr>
<tr>
<td>Sel de cuisine</td>
<td>0,5</td>
<td>0,5</td>
<td>0,5</td>
<td>0,5</td>
</tr>
<tr>
<td>Méthionine synthétique</td>
<td>0,25</td>
<td>0,25</td>
<td>0,25</td>
<td>0,25</td>
</tr>
<tr>
<td>Lysine synthétique</td>
<td>0,5</td>
<td>0,5</td>
<td>0,5</td>
<td>0,5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100,5</td>
</tr>
</tbody>
</table>

Caractéristiques chimiques calculées (%)

| Protéine brute       | 18,64 | 18,55 | 18,58 | 18,56 |
| Cellulose brute      | 3,8   | 3,8   | 3,7   | 3,8   |
| Lysine               | 1,2   | 1,3   | 1,3   | 1,3   |
| Méthionine           | 0,53  | 0,52  | 0,52  | 0,52  |
| Phosphore total      | 0,56  | 0,53  | 0,53  | 0,53  |
| Calcium              | 0,76  | 0,7   | 0,7   | 0,7   |
| Énergie métabolisable (Kcal/Kg) | 3063 | 3037 | 3038 | 3037 |

Coût de production de ration (FCFA/ Kg)

|               | 250,825 | 227,6   | 246,85 | 261,85 |

*Composition du CMAV 10% : (520g de protéine, 40g/kg de lipide, 90g/kg de calcium, 37,5g/kg de phosphore, 2300Kcal/kg d'énergie métabolisable, 28g/kg de lysine, 23g/kg de méthionine, 100g de vitamine: A (15x10^6 IU), D_3 (3x10^6 IU), E (53x10^6 mg), (mg/kg) vitamine: K₃ (26), B₉ (25), B₆ (60), B₁₂ (25), B₃ (0,3), Fe (1650mg/kg), Cu (200mg/kg), Zn (1300mg/kg), Mg (850mg/kg), Se (3mg/kg).*
la coccidiose à l’aide de Vetacox®; la Furaltadone® et l’oxytétracycline® leur ont été servies dans l’eau de boisson à partir du 10ème jour pendant 3 jours successifs et tous les 7 jours par la suite jusqu’à la 5ème semaine de production pour soigner des affections des voies respiratoires.

**Dispositif expérimental**

Les 160 poussins ont été logés par paire dans 80 cages distribuées au hasard à 4 groupes de 20 cages chacun. Chacune des 4 rations R0, R1, R2, R3 a été servie dans 10 unités de 2 cages (unité expérimentale) prises au hasard suivant un dispositif de plan complètement aléatoire à 4 traitements avec 10 répétitions chacun.

L’aliment et les poulets étaient pesés tous les 7 jours pour le calcul du gain de poids et de l’indice de consommation hebdomadaire.

A la fin de l’essai, 10 poulets par traitement ont été saignés et dressés pour l’étude des caractéristiques de la carcasse.

La créatinine a été dosée dans le sérum provenant des échantillons de sang prélevés à partir de la veine jugulaire des poulets saignés suivant la réaction de Jaffé (Test calorimétrique) à l’aide d’un kit commercial de la firme Boehringer Mannheim GmbH (Mannheim, Germany).

L’évaluation économique des rations a été faite uniquement sur la base du coût alimentaire de production du kg de poids vif de poulet.

**Analyse statistique**

Toutes les données étudiées ont été soumises à l’analyse de la variance suivant un dispositif expérimental en plan complètement randomisé à 4 traitements avec 10 répétitions par traitement. Lorsque la différence entre les moyennes des traitements était significative, la séparation des moyennes était faite à l’aide du test de Duncan.

**Résultats**

**Composition chimique des graines**

La composition bromatologique des graines de nièbe a varié en fonction de la méthode de traitement (Tableau 2). La teneur en énergie métabolisable a augmenté avec la cuisson et a diminué avec l’extrusion. Les taux de protéines brutes ont diminué lorsque les graines étaient soumises à la chaleur, quelle que soit la nature du traitement appliqué. Toutefois, les taux de matières organiques, de cendre, de lipide et de cellulose brute n’ont pas été différents.

**Tableau 2: La composition bromatologique analysée des farines de nièbe cru, cuit et extrudé**

<table>
<thead>
<tr>
<th>Nutriments</th>
<th>Nièbe cru</th>
<th>Nièbe cuit</th>
<th>Nièbe extrudé</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energie métabolisable (Kcal/kg,MS)</td>
<td>4460,89</td>
<td>4506,58</td>
<td>4355,71</td>
</tr>
<tr>
<td>Protéine brute (%)</td>
<td>26,51</td>
<td>25,47</td>
<td>20,08</td>
</tr>
<tr>
<td>Matière organique (%MS)</td>
<td>94,89</td>
<td>95,52</td>
<td>95,24</td>
</tr>
<tr>
<td>Matière sèche (%)</td>
<td>88,22</td>
<td>89,31</td>
<td>90,83</td>
</tr>
<tr>
<td>Cendre (%MS)</td>
<td>5,11</td>
<td>4,98</td>
<td>4,96</td>
</tr>
<tr>
<td>Lipides (%MS)</td>
<td>2,20</td>
<td>2,13</td>
<td>2,06</td>
</tr>
<tr>
<td>Cellulose brute (%MS)</td>
<td>5,28</td>
<td>5,27</td>
<td>4,99</td>
</tr>
</tbody>
</table>

*Energie métabolisable calculée selon Wiseman*
Tableau 3: Effets du type de traitement des grains de niébé sur les performances des poulets de 21 à 49 jours d'âge, sur le taux de la créatinine sérique et sur les caractéristiques de la carcasse à 49 j

<table>
<thead>
<tr>
<th>Paramètres</th>
<th>Ration Témoin (R₀)</th>
<th>Ration cru (R₁)</th>
<th>Ration cuit (R₂)</th>
<th>Ration extrudé (R₃)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consommation alimentaire (g)</td>
<td>3368,5±168a</td>
<td>3350,875±127a</td>
<td>3503,5±145a</td>
<td>3175,25±213,62c</td>
</tr>
<tr>
<td>Gain de poids (g)</td>
<td>1615,81±189,76ab</td>
<td>1606,73±139,07b</td>
<td>1716,70±169,70a</td>
<td>1258,51±178,51c</td>
</tr>
<tr>
<td>Indice de consommation</td>
<td>2,10±0,18a</td>
<td>2,04±0,33a</td>
<td>2,05±0,15a</td>
<td>2,55±0,27b</td>
</tr>
<tr>
<td>Coût de production du Kg de poids vif (FCFA)</td>
<td>708,76±112,33a</td>
<td>643,28±114,42a</td>
<td>662,31±87,83a</td>
<td>850,47±182,97a</td>
</tr>
<tr>
<td>Rendement carcasse (% PV)</td>
<td>73,09±1,69a</td>
<td>73,20±1,31a</td>
<td>74,08±0,64a</td>
<td>71,49±1,56b</td>
</tr>
<tr>
<td>Poids organe (g/Kg⁻¹ PV)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foie</td>
<td>3,15±0,36b</td>
<td>3,32±0,47ab</td>
<td>3,09±0,49b</td>
<td>3,59±0,44a</td>
</tr>
<tr>
<td>Coeur</td>
<td>1,57±0,33b</td>
<td>1,66±0,23b</td>
<td>1,70±0,33b</td>
<td>2,17±0,24a</td>
</tr>
<tr>
<td>Graisse abdominale</td>
<td>2,22±0,78b</td>
<td>2,28±0,97ab</td>
<td>2,35±0,62ab</td>
<td>2,99±0,55a</td>
</tr>
<tr>
<td>Taux de la créatinine sérique (mg/dl)</td>
<td>4,8±1,09a</td>
<td>6,00±0,00a</td>
<td>4,8±1,09a</td>
<td>5,6±0,89a</td>
</tr>
</tbody>
</table>

P, b, c: Les moyennes portant les mêmes lettres et suivies de l'écart-type sur la même ligne ne sont pas significativement différentes (P>0,05).
PV : Poids vif
FCFA : 1 Euro=655,95 (FCFA)

Consommation alimentaire
La consommation alimentaire totale significativement (P<0,05) la plus élevée a été celle des poulets du lot R2 nourris au niébé cuit comparée à celle de tous les autres lots (Tableau 3). La consommation alimentaire totale a été significativement (P<0,05) la plus faible pour les poulets nourris avec du niébé extrudé alors que le groupe témoin R0 et celui soumis au niébé cru (R1) n'ont pas été différents pour ce paramètre.

Gain de poids
Le gain de poids total (Tableau 3) des poulets R2 et R0 d'une part et celui des lots R0 et R1 d'autre part n'ont pas été significativement différents (P>0,05). Toutefois, les rations R0 et R2 ont permis d'enregistrer les gains de poids vifs significativement (P<0,05) les plus élevés alors que les poulets nourris avec le niébé extrudé R3 étaient les moins lourds (P<0,05).

Indice de consommation
Il n'y a pas eu de différence significative (P>0,05) entre les lots R0, R1 et R2 pour l'indice de consommation moyen (Tableau 3). Toutefois, ce paramètre a été significativement (P<0,05) le plus mauvais dans le lot des poussins nourris au niébé extrudé (R3).
Rendement carasse, caractéristiques de la carcasse et taux de créatinine sérique

Les poulets nourris au niébé extrudé ont enregistré le rendement carasse significativement (P<0,05) le plus faible comparé à tous les autres (Tableau 3).

De manière générale, les poulets issus du traitement R3 ont enregistré des proportions de foie, gésier, cœur et graisse abdominale significativement les plus élevées comparés aux poulets du lot témoin; il n'y a pas eu de différence significative entre les poulets R0, R1 et R2 pour ce paramètre. L'analyse statistique n'a révélé aucune différence (P>0,05) entre les traitements pour la concentration de la créatinine sérique.

L'analyse statistique des données relatives à l'évolution du coût de production du Kg de poids vif n'a fait ressortir aucune différence (P>0,05) entre les lots R0, R1, R2 pendant toute la période de production alors que les poussins nourris avec la ration contenant le niébé extrudé (R₃) ont enregistré le coût de production moyen le plus élevé (P<0,05).

Discussion

La quantité d'énergie métabolisable et le taux de protéines brutes obtenus pour le niébé cru sont supérieurs aux valeurs mentionnées par Borget¹⁹, Pasquet et Baudouin²⁰. Ces variations semblent être liées aux cultivars. De plus, la diminution importante du taux de protéines brutes observée dans les graines cuites de niébé extrudé serait liée à la dénaturation sous l'effet de la température et de la pression pendant l'extrusion tel que signalé par ailleurs par Crevieu¹⁴.

La consommation alimentaire totale a été significativement plus élevée dans le lot nourri avec la ration R2 contenant le niébé cuit alors que la ration R3 était la moins consommée de toutes. La plus faible consommation de la ration R3 par rapport à R2, pourrait suggérer que le goût de l'aliment contenant du niébé extrudé a pu être modifié. L'absence de différence significative entre le lot témoin et celui soumis au niébé cru pour la consommation totale est contraire aux observations de Huisman et Tolman¹⁰, Gatel¹¹, Wiryawan et Dingle²¹ et Téguaia et Beynen²². En effet pour ces auteurs, les facteurs anti-nutritionnels (FAN) présents dans le niébé cru (R1) sont responsables d'une mauvaise appétibilité des graines de niébé et devrait déprimer la consommation de cette ration. On pourrait penser que la variété de niébé utilisée dans cette expérience aurait une faible teneur en FAN. La consommation alimentaire totale des différents lots a été inférieure à la norme de 4787g suggérée par le sélectionneur de la souche²³ pour les poulets de chair mâles entre 21 et 49 jours. Elle se situe néanmoins dans la marge de 3000g à 3500g considérée comme normale²⁴. Par ailleurs, ces résultats sont conformes à ceux mentionnés par Japou¹³, Mbakop¹⁶ et Chakam¹⁷ sur des poulets de chair produits dans des conditions similaires.

Avec un gain de poids élevé des poulets du lot R2 par rapport à R3, on pourrait penser que la cuisson a amélioré l'utilisation des graines de niébé telle que signalé par ailleurs par Mbakop¹⁶ et Fleury²⁵. Le ralentissement de la croissance observé chez les poulets du lot R1 recevant le niébé cru par rapport au lot R2 pourrait s'expliquer par la présence des facteurs anti-nutritionnels dans les graines crus de niébé, occasionnant une faible digestibilité des nutriments¹,²,¹⁴,¹⁷,²²,²⁶. Ces résultats corroborent ceux de Wiryawan.
et Dingle et Lovell qui ont mentionné que la présence des FAN dans le niébé non traité provoque une volaille un ralentissement de la croissance et un abaissement du coefficient de transformation de la nourriture lorsque le taux d'incorporation est très élevé dans l'aliment. L'utilisation du niébé extrudé dans les conditions de la présente étude ne semble pas satisfaire les besoins nutritionnels des poulets. L'extrudeur a pu provoquer la dénaturation des protéines de réserve de la graine sous l'effet d'une température et d'une pression insuffisamment maîtrisée. Ces résultats semblent conformes à ceux de Colonna et Della Valle qui ont signalé que la valeur nutritionnelle de la graine extrudée décroît au-delà de 10% d'incorporation dans l'aliment.

L'indice de consommation moyen n'a pas été différent pour tous les lots à l'exception du lot R3 qui a enregistré une valeur significativement (P<0.05) la plus élevée. Une faible croissance associée à une consommation alimentaire médiocre semble être à l'origine de la mauvaise utilisation de la ration R3. Les meilleurs résultats obtenus dans le cadre du présent travail comparés à ceux de Mbakop et Chakam avaient utilisé respectivement du niébé bouilli et toasté semblent liés à une meilleure maîtrise des conditions de cuisson.

Le niébé extrudé a induit le rendement carcase le plus faible comparé à tous les autres lots. Il apparaît que chez ceux nourris avec la ration R3 contenant le niébé extrudé, il y a eu transfert des aliments vers les éléments du 5e quartier dont les proportions ont été plus grandes comparées à celles obtenues avec les autres rations. Toutefois, quel que soit le traitement considéré, le rendement carcase se rapproche des valeurs de Mountney. Bien qu'il n'existe pas de différence significative (P>0.05) entre R0, R1 et R2 pour le gésier et le cœur, on observe que l'inclusion du niébé dans l'aliment se traduit par une plus grande activité de ces organes qui croissent un peu plus. Ceci pourrait traduire la présence des FAN résiduels dans le niébé même après traitement. Toutefois, l'absence de différence significative entre les traitements pour le taux de créatinine sérique des poulets traduirait le fait que ces facteurs de toxicité n'atteignent pas encore un seuil critique. La concentration de la créatinine dans les différents lots a été très élevée comparée à la concentration normale (0.5-1.5mg/dl) suggérée par Coles. Ceci pourrait être attribué à l'utilisation de l'oxytetracycline pour soigner les affections des voies respiratoires des poulets pendant l'essai. En effet, Miller et al. ont signalé que l'azotémie qui est une concentration élevée de créatinine dans le sérum résulterait entre autre de la consommation des médicaments tels que la gentamicine, l'oxytetracycline, l'ampicilline B, le trimethoprim sulfadiazine et la furosémid. Ces produits réduisent la capacité d'excrétion des reins, entraînant une accumulation de l'azote ammoniacal dans le sang et donc une concentration élevée de la créatinine sérique.

Les coûts de production du Kg de poids vif des différentes rations ont été en général élevés comparés aux résultats obtenus par Mbakop et Chakam bien que l'indice de consommation dans le présent essai ait été meilleur comparé à ceux obtenus par ces auteurs. Par ailleurs, ces résultats contredisent Amaefule et Osuagwu que l'incorporation des graines crues de légumineuses dans la ration alimentaire des poulettes réduit significativement le coût alimentaire de production du Kg de poids.
vif. Ceci semble lié au coût du Kg d'aliment plus élevé dans la présente étude.

Conclusion

On peut conclure que la cuisson à une température d'environ 115°C sous une pression de 1517Pa pendant 3 minutes est le meilleur traitement des graines de niébé destinées à l'alimentation des poulets de chair.

Remerciements

Les auteurs remercient toutes les institutions et toutes les personnes qui ont contribué à la réalisation de ce travail: le Pr André Zoli P., Doyen de la Faculté d'Agronomie et des Sciences Agricoles (FASA) et responsable de la Ferme d'Application et de Recherche (FAR) de l'Université de Dschang, et son personnel, le responsable et le personnel du Laboratoire de Nutrition animale de l'Université de Dschang.

Bibliographie


Reçu pour publication le 30 novembre 2006
FIRST LACTATION PERFORMANCE AND CROSSBREEDING EFFECTS OF
FRIESIAN x BORAN CROSSES IN TANZANIA

H.W. Mwatawala1* and G.C. Kifaro2

1Institute of Rural Development Planning, P.O. Box 138 Dodoma, Tanzania
2Department of Animal Science and Production, Sokoine University of Agriculture,
P.O. Box 3004, Morogoro, Tanzania

PERFORMANCE DE LA PREMIERE LACTATION ET EFFETS DU CROISEMENT
FRISON x BORAN EN TANZANIE

Résumé

La présente étude a été menée an vue d'évaluer la performance de la première lactation et les effets du croisement de bovins laitiers Frison x Boran dans la région de Kagera en Tanzanie. Les paramètres étudiés étaient : la production laitière pour 100 jours, la production laitière pour 305 jours, la quantité de lait produite pendant la lactation (LPL), la durée de la lactation (DL), l'âge au premier vêlage (APV) et l'intervalle des vêlages (IV). Les données des divers paramètres étaient rassemblées pour la période 1982 - 1997. En moyenne, la production laitière pour 100 jours, la production laitière pour 305 jours, LPL et DL étaient respectivement de 686,4±6,5 kg ; 1977,3±17,6 kg ; 2178,7±18,6 kg et 371,6±1,8 jours. Les effets du groupe génétique et du district sur la production laitière pour 100 jours, la production laitière pour 305 jours et LPL étaient considérables (P<0,001). L'année de vêlage avait aussi un effet significatif (P<0,001) sur LPL et la production laitière pour 305 jours. Les effets du groupe génétique et de l'année de vêlage sur DL étaient énormes (P<0,05). En moyenne, APV et IV étaient de 38,2 mois et 484,3 jours respectivement. Les effets de tous les facteurs, à l'exception du district, sur APV étaient importants ; alors que pour IV, tous les effets étaient significatifs sauf la saison de vêlage. Le remplacement des Borans par des Frisons a abouti à un apport génétique supplémentaire de +876,5 kg (production laitière pour 100 jours) ; +1799,5 kg (production laitière pour 305 jours) ; +2290,1 kg (quantité de lait produite pendant la lactation) ; +100 jours (durée de la lactation) ; -20,4 mois (l'âge au premier vêlage) et -216,2 jours (intervalle des vêlages). Il a été conclu que la production laitière a augmenté en fonction du sang frison chez la progéniture et que la performance de la génération F2 était médiocre par rapport à F1. Il est recommandé d'améliorer la race jusqu'à 75% d'hérédité exotique sans une baisse concomitante de la performance de reproduction et de lactation.

Summary

This study was undertaken to evaluate first lactation performance and crossbreeding effects of crossbred dairy cattle involving Friesian and Boran breeds in Kagera region, Tanzania. Traits studied were 100-day milk yield, 305-day milk yield, lactation milk yield (LMY), lactation length (LL), age at first calving (AFC) and calving interval (CI). Records for the various traits were compiled covering the period between 1982 and 1997. The mean 100-day milk yield, 305-day milk yield, LMY and LL were 686.4 ± 6.5 kg, 1977.3 ± 17.6 kg, 2178.7 ± 18.6 kg and 371.6 ±1.8 days, respectively. The influences of genetic group and district on 100-day milk yield, 305-day milk yield and LMY were highly significant (P < 0.001). Year of calving also highly significantly (P < 0.001) affected LMY and 305-day milk yield. The effects of genetic group and year of calving on LL were significant (P < 0.05). The mean AFC and CI were 38.2 months and 484.3 days, respectively. Effects of all factors except district on AFC were significant, while for CI all effects were significant except season of calving. The replacement of Borans with Friesians resulted in additive genetic contributions of +876.5 kg 100-day yield, +1799.5 kg 305-day yield, +2290.1 kg lactation yield, +100.0 days lactation length, -20.4 months age of first calving and -216.2 days calving interval. It was concluded that milk increased with Friesian blood level in the progeny and that performance of F2 generation was poorer than F1. It is recommended that up-grading can be done up to 75% exotic inheritance without concomitant decline in reproductive and lactation performance.

Key words : Additive genetic effect, Heterosis, Lactation length, Milk yields

*Corresponding author: H. Banga-Mboko, e-mail henribanga@hotmail.com
Introduction

The use of *Bos taurus* x *Bos indicus* crosses, particularly for the dairy purposes is widespread in tropical and subtropical climate, because of their relatively higher production compared to the local populations in these environments. However, it has been reported that the optimum point of upgrading for milk production lies somewhere between 50% and 75% exotic inheritance. On the other hand, in order to plan a sound crossbreeding programme, information on the relative performances of breeds and their crosses, especially under varying environmental conditions is needed. Knowledge of the extent of variation attributed to additive and non-additive gene actions is of paramount importance. Examination of the performance of purebreds, $F_1$, $F_2$ and other upgraded generations of crosses allows a separate estimation of various genetic effects influencing performance.

High repeatability estimates for milk yield and high correlation of first lactation performance with subsequent lactations makes it essential in evaluating cows in their first lactation. This is important since it reduces generation interval and justifies early culling of very low yielding cows.

The Boran cattle breed is a zebu type that originated in the southern lowlands of Ethiopia. It is widely used for milk, meat, draught power and manure production. In Tanzania, it has been crossed with the Friesian breed with the aim of combining productivity and adaptability in the progeny.

In 1982, a small-scale dairy development project was started in Kagera region under Kagera Small Holder Dairy Extension Project (KSHDEP). The project was initiated in order to improve small-scale dairy production through provision of $F_1$ (Friesian x Boran) crossbred heifers to interested and willing farmers.

The purpose of this study was to evaluate the first lactation performance of Kagera herds of crossbred dairy cattle through quantifying sources of variation, which influence their milk production and reproduction potential. In addition, individual additive breed and heterotic effects for lactation performance are estimated.

Materials and methods

The study area

Kagera region is located in the Northwestern corner of Tanzania. It lies just below the equator between latitudes $1^\circ\ 00'\ $ and $2^\circ\ 45'\ $ south. Apart from vegetation arising from agricultural activities, the land surface is covered by natural grasses comprised of mainly *Cynodon* spp, *Panicum* spp, *Eragrostis* spp, and *Andropogon* spp. The region experiences continuous high rainfall from October to May. Months of January and February are slightly drier than other remaining months. June to August are dry months.

The Project

In 1982 a small-scale dairy development project was started in Kagera region under Kagera Small Holder Dairy Extension Project (KSHDEP). The project was initiated in order to improve small-scale dairy production through provision of $F_1$ crossbred heifers (Friesian x Boran) to interested and willing farmers. The $F_1$ heifers were being supplied by Kikulula Heifer Breeding Unit (KHBU), which was established in 1976. Some of the aspects
that were covered under KSHDEP were, improving data collection from indigenous herds, crossbreeding in the indigenous herds, supply of veterinary drugs and renovation of veterinary centres. In early 1990s Kagera Livestock Development Programme (KALIDEP) was formed which was the umbrella of four projects namely; KSHDEP, Kagera Indigenous Livestock Improvement Project (KILIP), KHBU and Kikulula Farmers Training Centre (KFTC).

Production records
Data that have been used in this study were extracted from KALIDEP monitoring unit and at KHBU in Kagera region. The improved dairy cattle dealt with in this study involved crosses of Friesian x Boran only. The traits studied were first lactation 100-day milk yield, 305-day milk yield, lactation milk yield (LMY), lactation length (LL), first calving interval and age at first calving. Source of data and data collection procedures are described in detail elsewhere.

Data analyses
Data were analyzed by General Linear Models (GLM) procedures. Two similar models were used. In the first model a genotypic effect was fitted, in the second model each genotype class was substituted by expected breed additive and heterozygosity effects fitted as covariates. There were four genetic groups: \( F_1 \) (\( \frac{1}{2} \) Friesian\( \frac{1}{2} \) Boran), \( F_2 \) (\( F_1 \times F_2 \)), \( F_3 \) Friesian crosses and \( \frac{3}{4} \) Friesian crosses. Additional fixed effects fitted in both models were birth and calving years from 1982-1997, districts: six (Bukoba rural, Bukoba urban, Muleba, Karagwe, Biharamulo, Ngara) and seasons of birth and calving were categorized into four classes as heavy wet season (March-May), light wet season (September-December), early dry season (January-February) and late dry season (June-August). The general structure of the full model that was used to analyze all traits can be presented in matrix form as follows:

\[ y = X_1 b_1 + X_2 b_2 + e \]

Where \( y \) represents one of the traits studied, \( b_1 \) represents all fixed effects other than genetic group, \( b_2 \) represents genetic group effects in model 1 or genetic effects (breed additive difference and heterosis) in model 2. \( X_1 \) represent the incidence matrices relating individual cow records to the fixed effects and \( X_2 \) is incidence matrix that relates individual cow records to the genetic group in model 1 or expected genetic coefficients for breed additive and heterosis in model 2. The random residual effects are represented by \( e \).

In the crossbreeding project females of the Friesian breed were not kept, only semen was imported. Due to that reason, heterosis was estimated indirectly from different combinations of crosses, e.g. by comparing \( F_1 \) with \( F_2 \).

The coefficients of breed additive \( (g_i) \) and heterosis \( (h_i) \) for each cow were derived following the procedure of Wolf and coallleagues. The following equations were used:

\[ g_i = \frac{1}{2}(\alpha_i + \alpha_i') \]

\[ h_i = \alpha_i s \alpha_i + \alpha_i d \alpha_i' \]

where \( \alpha_i s \) and \( \alpha_i d \) denote the gene proportion of breed \( i \) in the sire and dam of the animal, respectively. The genetic coefficients are given in Table 1.
Table 1: Number of records of various traits and expected genetic coefficients

<table>
<thead>
<tr>
<th>Traits</th>
<th>Genetic groups</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1/2 Friesian: 1/4 Boran</td>
<td>1/4 Friesian: 1/4 Boran</td>
<td>5/8 Friesian: 3/5 Boran</td>
<td>1/5 Friesian: 4/5 Boran</td>
<td></td>
</tr>
<tr>
<td>Age at first calving</td>
<td>1626</td>
<td>104</td>
<td>234</td>
<td>162</td>
<td></td>
</tr>
<tr>
<td>Calving interval</td>
<td>1964</td>
<td>79</td>
<td>222</td>
<td>170</td>
<td></td>
</tr>
<tr>
<td>100-day milk yield</td>
<td>1016</td>
<td>128</td>
<td>199</td>
<td>79</td>
<td></td>
</tr>
<tr>
<td>305-day milk yield</td>
<td>1069</td>
<td>75</td>
<td>219</td>
<td>112</td>
<td></td>
</tr>
<tr>
<td>Lactation milk yield</td>
<td>1623</td>
<td>99</td>
<td>222</td>
<td>143</td>
<td></td>
</tr>
<tr>
<td>Lactation length</td>
<td>1623</td>
<td>99</td>
<td>222</td>
<td>143</td>
<td></td>
</tr>
</tbody>
</table>

Genetic coefficients:

\[ g_F \] = 0.5

\[ h_{FE} \] = 0.5

\[ h_{FB} \] = 0.5

\[ g_{FB} \] indicate Friesian direct contribution relative to Boran and \[ h_{FB} \] is expected within locus heterozygosity for crossing Friesian with Boran.

Table 2: Analyses of variance for various traits studied

<table>
<thead>
<tr>
<th>Trait</th>
<th>Source of variation</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>District</td>
<td>Genetic group</td>
<td>Year</td>
<td>Season</td>
</tr>
<tr>
<td>100-day MY</td>
<td>Mean Square (x 10^5)</td>
<td>7.6</td>
<td>7.4</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td>F-Value</td>
<td>14.5</td>
<td>14.0</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>Probability</td>
<td>&lt; .0001</td>
<td>&lt; .0001</td>
<td>0.0602</td>
</tr>
<tr>
<td>305-day MY</td>
<td>Mean Square (x 10^6)</td>
<td>5.2</td>
<td>3.7</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td>F-Value</td>
<td>12.65</td>
<td>8.90</td>
<td>7.55</td>
</tr>
<tr>
<td></td>
<td>Probability</td>
<td>&lt; .0001</td>
<td>&lt; .0001</td>
<td>&lt; .0001</td>
</tr>
<tr>
<td>LMY</td>
<td>Mean Square (x 10^6)</td>
<td>9.3</td>
<td>7.8</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td>F-Value</td>
<td>14.07</td>
<td>11.76</td>
<td>2.90</td>
</tr>
<tr>
<td></td>
<td>Probability</td>
<td>&lt; .0001</td>
<td>&lt; .0001</td>
<td>&lt; .0001</td>
</tr>
<tr>
<td>LL</td>
<td>Mean Square (x 10^5)</td>
<td>6.4</td>
<td>18.5</td>
<td>14.8</td>
</tr>
<tr>
<td></td>
<td>F-Value</td>
<td>0.94</td>
<td>2.74</td>
<td>2.19</td>
</tr>
<tr>
<td></td>
<td>Probability</td>
<td>0.4508</td>
<td>0.0421</td>
<td>0.0064</td>
</tr>
<tr>
<td>AFC</td>
<td>Mean Square</td>
<td>96.4</td>
<td>657.6</td>
<td>595.1</td>
</tr>
<tr>
<td></td>
<td>F-Value</td>
<td>1.88</td>
<td>12.83</td>
<td>11.62</td>
</tr>
<tr>
<td></td>
<td>Probability</td>
<td>0.0943</td>
<td>&lt; .0001</td>
<td>&lt; .0001</td>
</tr>
<tr>
<td>CI</td>
<td>Mean Square (x 10^4)</td>
<td>3.0</td>
<td>12.9</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>F-Value</td>
<td>2.68</td>
<td>11.49</td>
<td>1.83</td>
</tr>
<tr>
<td></td>
<td>Probability</td>
<td>0.0200</td>
<td>&lt; .0001</td>
<td>0.0260</td>
</tr>
</tbody>
</table>
Results

100-day milk yield
The influences of genetic group and district on 100-day milk yield were highly significant (P < 0.001) (Table 2). Mean milk yield of F2 was significantly lower (by about 109 kg) as compared to F1. Also milk yields of F1 and 62.5% Friesian crosses were similar but lower by about 110 kg as compared to the yield of 75% Friesian crosses. Cows in Bukoba urban district had significantly higher 100-day milk yield compared to the rest of districts. Lowest 100-day milk yield was recorded in cows of Muleba district; however, this yield was not significantly different from other remaining districts. Year and season of calving had insignificant influence on 100-day milk yield.

305-day milk yield
Genetic group and district significantly affected 305-day milk yield (P < 0.001) (Table 2). Seventy five percent Friesian crosses produced 12% more milk than F1. However, F1 yielded 301 kg more of milk than F2. There was no significant difference in 305-day milk yield between F1 and 5/8 Friesian crosses although the 62.5% Friesian crosses out-yielded F1 by about 88 kg of milk.

The lowest mean yield was observed from Biharamulo district cows which was about 31% lower than the mean milk yield from Bukoba urban. However, this lowest milk yield was not significantly different (P>0.05) from the mean milk yields from Muleba, Karagwe and Ngara districts. There was no obvious trend in 305-day milk yield with time in years. However, 305-day milk yield that was recorded during 1989 was higher by about 21% compared to that recorded during 1995.

Lactation milk yield
The mean lactation milk yield (LMY) was 2178.9 kg and was highly significantly influenced by all factors included in the analysis except season of calving (Table 2). Mean LMY of 2427.6 kg for the 75% Friesian crosses was the highest in this study. As it was the case with 305-day milk yield, there was no trend in LMY with years. However the mean LMY for the period 1988-1990 was the highest and that for the period 1993-1997 was the lowest.

Lactation length
The analysis of variance and least squares means for LL is shown in Table 2 and 3, respectively. The overall mean LL was 371.6 days. Genetic group (P<0.05) and year of calving (P<0.01) significantly affected lactation length. There was no trend in lactation length due to year of calving. However, cows that calved in 1991 lactated longer (by 45 days) than those that calved in 1997.

Age at first calving and calving interval
All factors, except district, significantly influenced AFC (Table 2). Age at first calving was declining with increasing Friesian inheritance. However, it was significantly higher in F2 than in F1. The mean AFC of 39.6 months for the period during 1982-1986 was the highest, while the mean AFC during 1992-1996 period was the lowest (35.5 months). The period during 1987-1991 recorded the mean AFC of 37.7 months. Calving
interval tended to decline as levels of exotic inheritance increases. Cows in Ngara district had the highest mean calving interval compared to other districts. As it was the case in the other traits, there was no trend in calving interval with years. However, the mean calving interval of 484.4 days for the period during 1987-1991 was the lowest while the periods during 1982-1986 and during 1992-1997 had the mean calving intervals of 498.6 and 496 days, respectively.

Crossbreeding effects
Crossing of Friesian with Boran apparently resulted in desirable additive genetic contributions and heterosis in all traits (Table 5). There were positive heterotic effects of 19 to 31% for milk yield traits, 11% for LL and favourable negative effects for AFC and CI of 11 and 14%, respectively.

Discussion

100-day milk yield
The observed overall mean 100-day milk yield (Table 3) is slightly higher than 665.3 kg of milk previously reported from the Southern highlands of Tanzania9 which involved Friesian and Ayrshire crosses. The poor performance of F₂ compared to F₁ is not a new phenomenon as it has been demonstrated elsewhere³. This has been ascribed to a number of factors including reduction in heterosis as a result of recombination loss and partly because F₁ sires used in producing F₂ are not selected.

305-day milk yield
The overall 305-day milk yield of about 1977 kg (Table 3) is lower than the figures reported by previous authors¹⁰, ¹¹, ¹². However it is higher than the average reported by other workers¹³, ¹⁴. The increased performance with increase in the level of Friesian blood up to the ¾ Friesians is in agreement with earlier reports from India and Thailand¹², ¹⁵, ¹⁶. The decline in performance following inter se mating of F₁, is known to be associated with a reduction in heterozygosity and probably the breakdown in epistatic gene effects¹⁷. Other studies have reported increase in milk yield up to either F₁ or 5/8 Friesian and then declining yield with increased exotic blood¹⁰, ¹⁸.

The variation in 305-day milk yield due to districts can be attributed to the differences in management practices, agro ecological conditions and availability of market outlets for milk. Cows in Bukoba urban districts tended to yield more milk than cows from other districts, probably due to better access to various farm inputs, extension services and milk market. Msuya¹⁹ working with almost the same crossbred dairy cattle reported similar results. Similarly in India it was observed that cows in Northern region produced more milk than those reared in southern region¹⁰. Probably this is due to the climatic variations, since northern part is humid subtropical while the southern part is characterized by tropical and semi arid climates.

The absence of yearly trend in milk yield was expected as no selection scheme had been instituted. Annual variations can also be ascribed to random environmental effects.

Lactation milk yield
The mean LMY of about 2179 kg (Table 3) is higher than that reported on crosses between Mpwapwa cattle and Friesian, Ayrshire and Jersey¹³. However, another study¹⁶ working with Brown Swiss and Sahiwal crosses, reported a higher (2612kg)
lactation milk yield than in current study. Variation with other studies might be contributed by climatic conditions, management practices, levels of *Bos taurus* blood and the type of Zebu breed used.

The present superiority of milk yield of cows having more than 50% Friesian blood is indicative of a rather better management standard among farmers in the study area. However, in other studies it has been reported that cows with 50% Friesian blood performed better than higher grades\(^{21}\). Studies in Brazil\(^{22}\) have shown that F1s generally had higher milk yield, but their superiority over higher grades declined as the production level increased in response to improved production environment. The observed increase in LMY with increase in *Bos taurus* inheritance is in agreement with what has been demonstrated earlier\(^{16,20}\).

The observed non-significant effect of season of calving on LMY (Table 2) might be due to the fact that almost all animals are stall-fed and if there is proper nutrition of

Table 3: Least squares means (LSM) ± standard errors (s.e) of lactation traits

<table>
<thead>
<tr>
<th>Factor and levels</th>
<th>100-day MY (kg)</th>
<th>305-day MY (kg)</th>
<th>LMY (kg)</th>
<th>LL (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n LSM± s.e</td>
<td>n LSM± s.e</td>
<td>n LSM± s.e</td>
<td>n LSM± s.e</td>
</tr>
<tr>
<td>Overall</td>
<td>1422 686.4 ± 6.5</td>
<td>1415 1977.3 ± 17.6</td>
<td>2087 2178.7 ± 18.6</td>
<td>371.6 ± 1.8</td>
</tr>
<tr>
<td>Genetic group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F(_1)</td>
<td>1016 696.6 ± 8.8(^a)</td>
<td>1009 1918.9 ± 24.3(^a)</td>
<td>1623 2097.5 ± 25.4(^a)</td>
<td>372.0 ± 2.6(^a)</td>
</tr>
<tr>
<td>F(_2)</td>
<td>128 587.9 ± 21.6(^b)</td>
<td>75 1708.9 ± 75.7(^b)</td>
<td>99 1840.0 ± 85.6(^b)</td>
<td>347.8 ± 8.6(^b)</td>
</tr>
<tr>
<td>5/8 Friesian</td>
<td>199 696.2 ± 17.7(^a)</td>
<td>219 2006.9 ± 47.6(^a)</td>
<td>222 2229.5 ± 60.6(^a)</td>
<td>366.5 ± 6.1(^a)</td>
</tr>
<tr>
<td>% Friesian</td>
<td>79 806.5 ± 27.1(^c)</td>
<td>112 2173.2 ± 63.3(^c)</td>
<td>143 2427.6 ± 71.6(^c)</td>
<td>373.7 ± 7.2(^c)</td>
</tr>
<tr>
<td>District</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bukoba rural</td>
<td>335 687.6 ± 15.1(^a)</td>
<td>325 1975.8 ± 43.3(^a)</td>
<td>477 2160.5 ± 47.8(^a)</td>
<td>372.3 ± 4.8</td>
</tr>
<tr>
<td>Bukoba urban</td>
<td>212 822.9 ± 16.9(^b)</td>
<td>227 2291.9 ± 45.4(^b)</td>
<td>556 2475.5 ± 42.2(^b)</td>
<td>362.1 ± 4.3</td>
</tr>
<tr>
<td>Muleba</td>
<td>148 649.7 ± 21.1(^b)</td>
<td>133 1854.5 ± 62.2(^c)</td>
<td>182 2144.9 ± 70.8(^c)</td>
<td>363.9 ± 7.1</td>
</tr>
<tr>
<td>Karagwe</td>
<td>426 658.9 ± 13.8(^b)</td>
<td>467 1880.0 ± 39.4(^c)</td>
<td>592 2072.0 ± 45.5(^c)</td>
<td>365.4 ± 4.6</td>
</tr>
<tr>
<td>Bharamulo</td>
<td>130 704.6 ± 23.3(^b)</td>
<td>107 1826.4 ± 67.5(^c)</td>
<td>125 2013.8 ± 79.1(^c)</td>
<td>359.5 ± 8.0</td>
</tr>
<tr>
<td>Ngara</td>
<td>171 657.2 ± 20.8(^b)</td>
<td>156 1883.5 ± 59.6(^c)</td>
<td>155 2025.1 ± 74.4(^c)</td>
<td>366.8 ± 7.5</td>
</tr>
<tr>
<td>Season of calving</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy rain season</td>
<td>255 674.1 ± 16.7</td>
<td>273 1941.7 ± 45.1</td>
<td>423 2109.7 ± 49.1</td>
<td>360.6 ± 5.0</td>
</tr>
<tr>
<td>Light rain season</td>
<td>659 702.6 ± 12.4</td>
<td>693 1911.8 ± 36.5</td>
<td>815 2111.6 ± 42.5</td>
<td>362.8 ± 4.3</td>
</tr>
<tr>
<td>Early dry season</td>
<td>203 699.2 ± 18.5</td>
<td>220 1958.9 ± 50.5</td>
<td>381 2204.6 ± 52.3</td>
<td>371.4 ± 5.3</td>
</tr>
<tr>
<td>Late dry season</td>
<td>305 711.3 ± 15.6</td>
<td>329 1995.6 ± 43.5</td>
<td>468 2168.7 ± 49.1</td>
<td>365.2 ± 5.0</td>
</tr>
<tr>
<td>Year</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1983</td>
<td>-</td>
<td>88 1910.1 ± 97.9(^a)</td>
<td>362.5 ± 9.9(^a)</td>
<td></td>
</tr>
<tr>
<td>1984</td>
<td>-</td>
<td>105 2172.9 ± 92.4(^c)</td>
<td>374.6 ± 9.3(^c)</td>
<td></td>
</tr>
<tr>
<td>1985</td>
<td>-</td>
<td>91 2163.9 ± 96.3(^b)</td>
<td>357.4 ± 9.7(^b)</td>
<td></td>
</tr>
<tr>
<td>1986</td>
<td>-</td>
<td>163 2176.4 ± 74.7(^c)</td>
<td>363.3 ± 7.5(^c)</td>
<td></td>
</tr>
<tr>
<td>1987</td>
<td>-</td>
<td>165 2347.7 ± 72.6(^c)</td>
<td>367.7 ± 7.3(^c)</td>
<td></td>
</tr>
<tr>
<td>1988</td>
<td>-</td>
<td>142 2231.3 ± 76.6(^c)</td>
<td>366.3 ± 7.7(^c)</td>
<td></td>
</tr>
<tr>
<td>1989</td>
<td>116 752.5 ± 23.5</td>
<td>149 2094.2 ± 58.6(^a)</td>
<td>98 2119.2 ± 7.5(^bc)</td>
<td>350.9 ± 8.8</td>
</tr>
<tr>
<td>1990</td>
<td>168 699.6 ± 19.6</td>
<td>166 2040.7 ± 56.1(^a)</td>
<td>119 2269.8 ± 8.9(^bc)</td>
<td>369.8 ± 7.8</td>
</tr>
<tr>
<td>1991</td>
<td>192 690.4 ± 19.1</td>
<td>204 1897.3 ± 53.4(^b)</td>
<td>168 2226.2 ± 9.9(^bc)</td>
<td>387.5 ± 7.0</td>
</tr>
<tr>
<td>1992</td>
<td>224 684.9 ± 18.5</td>
<td>234 1946.6 ± 50.8(^b)</td>
<td>185 2222.8 ± 8.1(^c)</td>
<td>377.1 ± 6.9(^b)</td>
</tr>
<tr>
<td>1993</td>
<td>219 699.5 ± 18.1</td>
<td>243 2038.1 ± 48.6(^b)</td>
<td>198 2245.6 ± 64.9(^c)</td>
<td>362.3 ± 6.6</td>
</tr>
<tr>
<td>1994</td>
<td>258 691.1 ± 16.9</td>
<td>273 1984.8 ± 46.1(^b)</td>
<td>216 2131.7 ± 61.2(^c)</td>
<td>362.5 ± 6.2</td>
</tr>
<tr>
<td>1995</td>
<td>245 659.6 ± 18.0</td>
<td>146 1662.1 ± 57.9(^c)</td>
<td>131 1717.6 ± 77.1(^c)</td>
<td>371.0 ± 7.8(^c)</td>
</tr>
<tr>
<td>1996</td>
<td>-</td>
<td>97 2140.2 ± 86.5(^c)</td>
<td>360.1 ± 8.7(^c)</td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>-</td>
<td>119 2154.7 ± 80.9(^c)</td>
<td>342.0 ± 2.0</td>
<td></td>
</tr>
</tbody>
</table>

Means with the same superscripts within a column and a factor do not differ significantly (P>0.05).
cows then influence of season on LMY can be less apparent. A similar observation was reported from India\textsuperscript{21}.

**Lactation length**

The observed mean LL is relatively higher than the average LL for *Bos taurus* and crossbred cattle in most parts of the tropics which have ranged between 265 and 352 days\textsuperscript{10, 15, 16, 17}. The rather long LL is associated with long CI observed in this population. With long CI, the depressive effect of new pregnancy is also deferred resulting in cows to lactate for a longer period. The significant variation of LL with years could be attributed to changes in climatic factors and hence availability of forages and changes in management levels.

**Age at first calving and calving interval**

The observed age at first calving of 38.2 months (Table 4) is in agreement with findings made in Ethiopia\textsuperscript{23}. However it is higher than the figure of about 34 months reported by other workers who studied crossbred dairy cattle in the Ethiopian highlands\textsuperscript{24}. Significant differences in age at first calving due to season and year of birth

### Table 4: Least squares means (LSM) ± standard errors (s.e) of age at first calving and calving interval

<table>
<thead>
<tr>
<th>Factor and levels</th>
<th>AFC (months)</th>
<th>CI (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>LSM± s.e</td>
</tr>
<tr>
<td>Overall</td>
<td>1934</td>
<td>38.2 ± 0.2</td>
</tr>
<tr>
<td><strong>Genetic group</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F\textsubscript{1}</td>
<td>1452</td>
<td>38.4 ± 0.2\textsuperscript{a}</td>
</tr>
<tr>
<td>F\textsubscript{2}</td>
<td>86</td>
<td>39.2 ± 0.8\textsuperscript{b}</td>
</tr>
<tr>
<td>5/8 Friesian</td>
<td>234</td>
<td>37.0 ± 0.5\textsuperscript{c}</td>
</tr>
<tr>
<td>¾ Friesian</td>
<td>162</td>
<td>35.8 ± 0.6\textsuperscript{d}</td>
</tr>
<tr>
<td><strong>District</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bukoba rural</td>
<td>468</td>
<td>37.2 ± 0.4</td>
</tr>
<tr>
<td>Bukoba urban</td>
<td>434</td>
<td>36.8 ± 0.4</td>
</tr>
<tr>
<td>Muleba</td>
<td>172</td>
<td>38.5 ± 0.6</td>
</tr>
<tr>
<td>Karagwe</td>
<td>578</td>
<td>37.9 ± 0.4</td>
</tr>
<tr>
<td>Biharamulo</td>
<td>107</td>
<td>37.7 ± 0.8</td>
</tr>
<tr>
<td>Ngara</td>
<td>175</td>
<td>37.5 ± 0.6</td>
</tr>
<tr>
<td><strong>Season of birth/calving</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy rain season</td>
<td>499</td>
<td>38.0 ± 0.4\textsuperscript{a}</td>
</tr>
<tr>
<td>Light rain season</td>
<td>639</td>
<td>37.0 ± 0.4\textsuperscript{b}</td>
</tr>
<tr>
<td>Early dry season</td>
<td>363</td>
<td>38.4 ± 0.5\textsuperscript{a}</td>
</tr>
<tr>
<td>Late dry season</td>
<td>433</td>
<td>37.0 ± 0.4\textsuperscript{b}</td>
</tr>
<tr>
<td><strong>Year</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1982</td>
<td>131</td>
<td>40.1 ± 0.8\textsuperscript{a}</td>
</tr>
<tr>
<td>1983</td>
<td>161</td>
<td>42.5 ± 0.7\textsuperscript{b}</td>
</tr>
<tr>
<td>1984</td>
<td>117</td>
<td>39.3 ± 0.8\textsuperscript{c}</td>
</tr>
<tr>
<td>1985</td>
<td>113</td>
<td>38.2 ± 0.7\textsuperscript{c}</td>
</tr>
<tr>
<td>1986</td>
<td>101</td>
<td>37.8 ± 0.8\textsuperscript{c}</td>
</tr>
<tr>
<td>1987</td>
<td>129</td>
<td>38.4 ± 0.7\textsuperscript{c}</td>
</tr>
<tr>
<td>1988</td>
<td>199</td>
<td>37.1 ± 0.6\textsuperscript{c}</td>
</tr>
<tr>
<td>1989</td>
<td>190</td>
<td>37.7 ± 0.6\textsuperscript{c}</td>
</tr>
<tr>
<td>1990</td>
<td>183</td>
<td>38.9 ± 0.6\textsuperscript{c}</td>
</tr>
<tr>
<td>1991</td>
<td>193</td>
<td>36.4 ± 0.6\textsuperscript{d}</td>
</tr>
<tr>
<td>1992</td>
<td>136</td>
<td>36.3 ± 0.7\textsuperscript{d}</td>
</tr>
<tr>
<td>1993</td>
<td>103</td>
<td>35.0 ± 0.8\textsuperscript{de}</td>
</tr>
<tr>
<td>1994</td>
<td>58</td>
<td>38.7 ± 1.0\textsuperscript{c}</td>
</tr>
<tr>
<td>1995</td>
<td>59</td>
<td>34.9 ± 1.0\textsuperscript{de}</td>
</tr>
<tr>
<td>1996</td>
<td>61</td>
<td>32.8 ± 1.0\textsuperscript{de}</td>
</tr>
</tbody>
</table>

Means with the same superscripts within a column and a factor do not differ significantly (P > 0.05).
Table 5: Friesian additive genetic effects and heterosis for F1

<table>
<thead>
<tr>
<th>Trait</th>
<th>Friesian additive genetic contribution</th>
<th>Heterosis estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-day milk yield</td>
<td>876.5 ± 136.3 kg (P &lt; .0001)</td>
<td>214.6 kg (31%) (P &lt; .0001)</td>
</tr>
<tr>
<td>305-day milk yield</td>
<td>1799.5 ± 383.5 kg (P &lt; .0001)</td>
<td>334.7 kg (17%) (P &lt; .0125)</td>
</tr>
<tr>
<td>Lactation milk yield</td>
<td>2290.1 ± 435.6 kg (P &lt; .0001)</td>
<td>409.1 kg (19%) (P &lt; .0066)</td>
</tr>
<tr>
<td>Lactation length</td>
<td>100.0 ± 43.9 days (P &lt; .0229)</td>
<td>42.1 days (11%) (P &lt; .0057)</td>
</tr>
<tr>
<td>Age at first calving</td>
<td>-20.4 ± 3.7 months (P &lt; .0001)</td>
<td>-4.1 months (11%) (P &lt; .0016)</td>
</tr>
<tr>
<td>Calving interval</td>
<td>-216.2 ± 57.1 days (P &lt; .00002)</td>
<td>-67.1 days (14%) (P &lt; .0011)</td>
</tr>
</tbody>
</table>

may probably be attributed to variations in feed availability and changes in management among different years.

The observed long CI (Table 4) might be due to management and technical problems especially poor heat detection, inadequate feeding especially mineral supplementation, lack of breeding bulls and unaffordable AI service. Other workers have reported relatively shorter CI than the present one. The decline in CI with increase in exotic inheritance is however contrary to previous reports. However, F1 cows calved again significantly earlier than F2 cows and this could partly be attributed to reduced heterosis in F2 crosses. The effect of year of calving could be associated with variability in management (i.e. breeding methods and their reliability, feeding levels and supplementation) and climate especially rainfall between different years.

Crossbreeding effects

The relatively high estimates for yield traits may be biased because of confounding between unbalanced genetic group and unaccounted herd effects. Heterosis for 305-day and lactation yields agrees with earlier findings. The observed heterosis estimates and Friesian additive contribution for AFC and CI are higher than the figures reported for the Friesian x Boran crosses in Ethiopia. Also the reported heterosis for calving interval is higher than the estimates reported in earlier studies. However, heterosis estimate for AFC is within the range reported from the study conducted in Ethiopia.

Conclusions

Results obtained from this study indicate that both genetic and non-genetic factors contribute considerably to the variation in first lactation performance, particularly milk yield traits. Genotype was an important source of variation for all traits considered in this study. Cows with three quarters Friesian inheritance were superior in almost all traits while the F2 have shown to be the poorest. It has been demonstrated further that seasonal effects were not important in Kagera region and yearly differences can be ignored if selection is done annually. Crossbreeding of Friesian and Boran has improved all traits with heterosis estimates ranging from 11 to 31%. It is recommended that up-grading can be done
up to 75% exotic inheritance without concomitant decline in reproductive and lactation performance.

Acknowledgements

The financial support from SUA-MU ENRECA and PHSL projects is highly acknowledged for enabling authors conduct this study successfully. Also the cooperation and support from the late Prof. Poul H. Petersen of KVL, Denmark and KALIDEP staff during data collection is highly acknowledged.

References


Received for publication on 16th February, 2007.
Goats are a major source of animal protein in Nigeria, supplying up to about 108, 700 tonnes of meat annually\textsuperscript{1}. Goats also supply milk, skin and manure. In Nigeria, goats are kept mainly as a source of meat, with little emphasis on milk production\textsuperscript{2}. The projected goat population in the country is 42.01 million, while sheep accounts for 26.27 million\textsuperscript{3}. Resource Inventory and Management (RIM)\textsuperscript{4} reported that in sub-Saharan Africa there are more than 142.5 million goats, with Nigeria having up to one quarter of the total population.

There is a general outcry of animal protein shortage in the developing countries\textsuperscript{5} the average per capita daily intake of animal protein is only between 12-20g or 3 to 4 times lower than what is reported in the developed countries\textsuperscript{6}. Similarly, the average milk consumption per capita per year in the developed countries stands at 200kg, while in the developing countries is 5.5 times lower. This calls for concerted efforts to increase dairy goat production.

In Nigeria, goat milk is rarely used for human consumption. However, there is a growing awareness on the importance of goat milk consumption world wide\textsuperscript{7}. Johnson\textsuperscript{8} reported that in Britain and the United States of America, there is a growing demand for goat milk for therapeutic use, which cannot be deterred by the higher labour cost of goat milk production. Goat milk is more widely produced than sheep milk in Nigeria\textsuperscript{5}. Globally, goat production yields 60% of the value as milk, 35% as meat and 5% as skin\textsuperscript{9}. It has been shown that countries like Iraq and Libya obtain half of their total milk requirements from goats. Davendra and McIroy\textsuperscript{10} reported that in terms of live weight goats is much more efficient in producing milk than other species of farm animals.

Mastitis has been described as one of the common disease conditions that prevent effective production of milk in many species of farm animals such as cattle, sheep and goats\textsuperscript{11}. Other causes include lack of enough balanced rations, improper housing and poor management strategies\textsuperscript{12}. There is a paucity of information on the prevalence rate of mastitis especially on the indigenous farm animal species, in cattle\textsuperscript{13}, in goats\textsuperscript{14,15}. This study was therefore undertaken to investigate the effect of genotype and age on the prevalence of mastitis in the Nigerian goat breeds in Bauchi.

Bauchi Metropolis, the study area, a part from being the state capital and headquarters of Bauchi Local Government, is also the urban centre in the state. Bauchi is located on latitude 10\textdegree\textit{9} 171 North, longitude 9\textdegree\textit{9} 171 and at an altitude of 690.2 meters above sea level\textsuperscript{16}. The data for this study were collected from Bauchi Metropolitan abattoir. The animals sampled...
Table 1: Prevalence of mastitis in goats

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Number of animals positive for mastitis</th>
<th>Number of animals negative for mastitis</th>
<th>Total number of animals sampled</th>
<th>Rate of infection (%)</th>
<th>$\chi^2$</th>
<th>LOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Sokoto</td>
<td>452</td>
<td>395</td>
<td>847</td>
<td>53.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kano Brown</td>
<td>263</td>
<td>245</td>
<td>508</td>
<td>51.77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sahel</td>
<td>110</td>
<td>108</td>
<td>218</td>
<td>50.46</td>
<td>15.56</td>
<td>*</td>
</tr>
<tr>
<td>West African Dwarf</td>
<td>06</td>
<td>15</td>
<td>21</td>
<td>28.57</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crosses</td>
<td>165</td>
<td>157</td>
<td>322</td>
<td>51.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Young</td>
<td>134</td>
<td>255</td>
<td>389</td>
<td>34.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mature</td>
<td>306</td>
<td>408</td>
<td>714</td>
<td>42.9</td>
<td>152.1</td>
<td>***</td>
</tr>
<tr>
<td>Old</td>
<td>556</td>
<td>257</td>
<td>813</td>
<td>68.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LOS = Level of significance: *P<0.05; ***P<0.001

were Red Sokoto (RS), Kano Brown (KB), Sahel goats (SG), West African Dwarf goats (WAD) and their crosses (crosses of RS, SG and WAD)(CR). These animals were from surrounding villages or from neighboring local government areas. The management system is mostly traditional and this ranges from free range grazing and browsing with little or no supplementary feeding during the non-cropping period to tethering with zero grazing during the cropping season. A total number of 1,916 does were randomly sampled as they entered the slaughter slab. Out of this, 847 were RS, 508 KB, 218 SG, 21 WAD and 322 CR. The age was determined by the dentition method as described by Butswat. Samples of milk/udder tissues were collected in test tubes post mortem and were immediately transported from the abattoir to the laboratory for analysis for mastitis using the procedures (Whiteside test) described by Robert. The study lasted for a period of eight months (August, 2002 to March, 2005). The data were collected every five days throughout the study period. The data generated from this study were subjected to chi-square ($\chi^2$) analysis described by Humburg, using breed and age as factors. The results showed that infection rates among the breeds were significantly different (P<0.05); values being 53.36, 51.77, 50.46, 28.57 and 51.24% for the RS, KB, SG, WAD and CR respectively (Table 1), and the younger goats have a lower prevalence rate (34.4%) compared to others (42.9% and 68.4% for mature and older does respectively).
The prevalence rates obtained in this study was much higher than the values of 16.04 and 9.40% reported by Lafi et al.\textsuperscript{1} and is similar to the values reported by Alawa et al.\textsuperscript{22} and Ameh et al.\textsuperscript{23} who reported an infection rate of 30.3% and 76.1% for goats having unilateral enlargement, and 31.6% and 23.97% for goats with bilateral enlargement.

The high prevalence rate on the one hand and the breed difference on the other hand could also be associated with the high milk potentials of these breeds as reported by Butswat et al.\textsuperscript{5}. This implies that the goat breeds that are high milk yielders are likely to have higher prevalence rate of the disease than their low milk yielding counterparts. Alawa et al.\textsuperscript{22} reported that the Red Sokoto, Kano Brown goats and their crosses are relatively high milk yielders compared to the West African Dwarf goat known for its low milk production\textsuperscript{24,25}.

It has also been shown that the large udder of goats and the long lactiferous sinuses which are prone to blockage with infected residual milk because the milk might not be completely stripped out, lead to increased likelihood of frequent lactiferous sinus blockage, which may subsequently lead to the damming of milk in the udder during lactation.

The age difference is in conformity with the study of Dasgupta et al.\textsuperscript{26} in India who reported an infection rates of 48.7% in older goats and 31.3%, 20.0% for matured and younger goats respectively.

This study concludes that improvement in management practices will go a long way in increasing goat milk production in the study area. It is also suggested that animals raised under different management systems should be studied to establish if there is true a breed variation in the prevalence of mastitis and the possibility of using such genotype for dairy goat selection in the area.

References


Received for publication on 31st August, 2004
SHORT COMMUNICATION

ISOLATION OF HIGHLY PATHOGENIC AVIAN INFLUENZA (HPAI)
H5N1 IN THE SUDAN

Selma, O. A. and Jeddah, I. E

Central Veterinary Research Laborotaries, Soba,
Khartoum Sudan. P.O.Box 8067.

Highly pathogenic avian influenza (HPAI) is caused by a specified influenza A viruses that are members of the family *Orthomyxoviridae*. There are three influenza types: A, B and C. Only influenza type A viruses are known to infect birds. The disease was initially recognized as an infectious disease of birds in Italy since 1878.

In 1901 a filterable agent causing the disease was identified, and later in 1955, it was characterized as influenza type A viruses. Low pathogenic avian influenza virus (LPAIV) strains are transmitted from reservoir hosts with asymptomatic course of influenza type A, to highly susceptible poultry species such as chickens and turkeys. These strains may undergo insertion mutations, trans-species transmission steps resulting into highly pathogenic avian influenza viruses (HPAIV). HPAI virus is characterized by a sudden onset, severe illness of a short duration and a mortality approaching 100 %. Recently avian influenza acquired world-wide attention and highly pathogenic strains of subtype H5N1 gained enzootic status in poultry throughout the world.

This paper describes the first report of highly pathogenic avian influenza virus in Sudan, its isolation and identification as H5. The causative virus was then characterized and confirmed as H5N1 by OIE, FAO and National Reference Laboratory for Newcastle disease and avian Influenza.

By the end of March 2006 severe field outbreaks in chickens were reported to the Central Veterinary Research Laboratory, Soba, Sudan. Outbreaks were reported from different farms: in Wad Madeni, Shukaba village south of Gezira state, River Nile State and Khartoum State. Outbreaks occurred in layers and breeders, the age ranged from 6-18 months some were in open houses and others in closed and semi-closed systems. Post mortem lesions were variable but mostly showed congested trachea and livers ecchymotic haemorrhages at the proventriculus gizzard junction, severe enteritis and nephritis. Cloacal swabs from diseased birds (average 10 birds from each farm were tested for influenza type A virus by Rapid Antigen Test Kit (Synbiotic Corporation, USA/France) subsequently positive samples were tested for influenza subtype H5 by the Rapid Anigen test kit. Following necropsy, tracheas, lungs and livers were removed aseptically and stored at -20 till processed for virus isolation.

*Corresponding Author: XXXXXXXX*
Isolation of the causative agent was performed as described by OIE. It was attempted in the first two outbreaks of wad Madeni, Shukaba village and River Nile. Tissue samoles were processed by grinding each sample in PBS to make a 10-20% tissue suspension. This was clarified by low speed centrifugation at 500-1500 g for 10 minutes. The supernatant was then treated with 10,000 IU of penicillin, 10,000µg streptomycin per ml. Following centrifugation, 0.2 ml of the supernatant from each sample was inoculated via the allantoic sac into five 9 day-old embryonated chicken eggs. Eggs were incubated at 37°C for 4-7 days and candled daily. All deaths occurring within 24 hours post inoculation were regarded as nonspecific and discarded. The allantoic fluid from each egg of embryos that died from 2-7 days, were harvested and tested for haemagglutination activity (HA). Detection of HA activity indicates presence of influenza type A virus or an avian paramyxovirus. Fluids with negative reactions were passaged two times more. Haemagglutination inhibition (HI) test was performed using Newcastle disease serum (to exclude Newcastle virus). ND negative allantoic fluids were then tested with influenza antiserum. The chorioallantoic memberanes (CAMs) from the inoculated eggs with HA positive allantoic fluids, were collected, minced, homogenized and freeze-thawed three times followed by centrifugation at 1000 g for 10 minutes. The supernatant fluid was inactivated by the addition of 0.1% formalin, recentrifuged and used as antigen in the agar gel immunodiffusion (AGID) test. The test was carried out as described earlier, using 1.0 gm purified agar, 8% NaCl in Phosphate buffered saline (PBS) pH 7.2. A pattern of wells were cut to place each suspect antigen adjacent to a known positive antiserum and antigen (Animal Health Intervet International AK Z0 Nobel, Netherlands). Two tests were done: one using influenza type A antiserum and antigen, the other using Influenza subtype H5 antiserum and type A antigen.

Haemagglutination test is carried out as described elsewhere. Using U shaped microtiter plate; two fold dilutions of infected allantoic fluid were prepared in quantities of 0.025 ml of PBS. One percent suspension of chicken red blood cells (RBCs) was then added to virus dilutions at the rate of 0.025 ml. The test was read after incubation for 40 minutes at room temperature.

Two-fold dilutions of influenza virus antiserum (Animal Health Intervet International AK Z0 Nobel, Netherlands) was made with 0.025 ml PBS in U-Shaped microtitre plate. An equal volume of allantoic fluid containing 4 HA units was added to each well and the plate was incubated at room temperature for 30 minutes. Two rows of wells were left as controls. One row contained positive control antigen and the second row contained PBS (RBCs control). 0.025 ml RBCs was added to each of the wells. The plate was gently shaken and incubated at room temperature for 40 minutes.

Positive influenza type A specimens (allantic fluids and organs) were sent for confirmation and characterization to the OIE, FAO and National Reference Laboratory for Newcastle disease and avian Influenza.

The inoculated eggs died within the second and third day of inoculation. The infected allantoic fluids showed rapid HA activity which was not inhibited with Newcastle disease serum.
Haemagglutination inhibition HAI test performed with influenza antiserum was positive. For Medani isolate HA titre was 7 log₂ and HI was 9 log₂, and for Atbara isolate HA titre was 8 log₂ and HI was 11 log₂.

The AGID test showed white precipitin line between the control antigen and antiserum of Influenza type A, which is continuous with the line of the two test antigens. The test also showed precipitin line between Influenza type A antigen and Influenza subtype 5 antiserum which was continuous with the line of the two test antigen. The HA and the HI tests and the AGID tests identified the causative virus as influenza type A and subtype 5.

Further, the allantoic fluids and organs of diseased chickens from these outbreaks that were sent to OIE, FAO and National Laboratory for Newcastle Disease and Avian Influenza were confirmed positive by RT/PCR as H5N1 and showed a sequence of PQGEGRRKKGRLFGAIA (HPAI).

The presence of highly pathogenic avian influenza HPAI/H5N1 in poultry is thus reported in the Sudan for the first time. Up to the end of 2003, HPAI was considered a rare disease in poultry. Since 1959 only 24 primary outbreaks had been reported worldwide. The majority occurred in Europe and the Americas; outbreaks were geographically limited. By 2003-2004 the Asian outbreaks of H5N1 was overwhelming. It gained enzootic status in poultry and unexpectedly was transmitted from birds to mammals (cats, swine and humans). In April 2005, H5N1 strain gained access to wild birds' populations on a large scale, and thus comes the role of migratory wild and aquatic birds for spreading the disease. In consequences, HPAI outbreaks, along and between overlapping migratory flyways from inner Asia towards the Middle East and Africa hit several countries. The Sudan like wise is considered one of the migratory flyways of birds and probably this could be the major cause of introduction of the disease to poultry in Sudan. This also raises concerns of transmission of influenza virus (H5N1) from poultry to human as backyard poultry raising is a common practice in the Sudan, which facilitates close contact of humans with domestic poultry.

Acknowledgement

The authors would like to express their thanks to the General Director Animal Resources Research Corporation for his permission to publish. Our gratitude is extended to the Director Central Veterinary Research Laboratories and Director Animal Diseases Research Division for their follow up and moral support. Thanks are due to the Technicians Mohammed Abdel-Rahman, Omar Al-Nor and Salwa Ali, for their technical assistance.

References

Ames 135-160.


Received for publication on 04th July, 2007
COMPARATIVE PHYSIOLOGICAL PARAMETERS IN WEST AFRICAN DWARF AND YANKASA SHEEP

1Adewumi, O.O. 2Chineke C.A. 3Alokan, J.A. and Bakare, A.O.

1Department of Animal Production and Health Sciences, University of Ado-Ekiti, Ekiti State

2Department of Animal Production and Health, Federal University of Technology, Ondo State

The West African Dwarf (WAD) sheep is widely reared mainly in the forest zone of Nigeria while Yankasa (YK) are primarily bred by the Fulani in North Central Nigeria. Physiological parameter including their body temperature, respiratory rate and pulse rate have been shown to be of value in the determination of health status and adaptability of domestic animal in stress situation. The parameters are easily measured and, therefore, could be valuable in the assessment of susceptibility of West African Dwarf sheep to stress where basic laboratory facilities may not be available and to assess the adaptability of Yankasa sheep to the forest zone of Nigeria. Body temperature, which is usually measured as rectal temperature, pulse rate and respiratory rate, has been demonstrated to be of value in the assessment of meteorological stress in farm animals. High ambient temperatures have been shown to affect male fertility, survival rate of fetuses, daily feed intake, daily weight gain and food conversion efficiency. Literature on the comparative physiological parameters of YK and WAD during the hot rainy season is scanty. Such findings maybe of value in the evaluation of clinical diagnosis, prophylactic, therapy of disease, selective upgrading of indigenous breed of sheep and adaptability to the forest zone of Nigeria. The aim of this study was to compare the rectal temperature, respiratory rate and pulse rate in West African Dwarf and Yankasa sheep in order to evaluate the thermoregulatory capacity and adaptation of the latter to forest zone of Nigeria.

A total of both twelve yearling West African Dwarf with mean and SEM(12.20kg ± 0.36) and Yankasa with mean and SEM (15.48KG ± 0.26) between the ages of 8 and 12months were used for the study. The West African Dwarf and Yankasa were bought from local farmers at Ikoroko (South-West) and Zaria (North) respectively. Their pen was made of concrete floor not slatted with a roofing sheet and an open yard for exercise. The side wall was made of wood and had a height of 2m. The experiment was carried out between the month of June and July during the hot rainy season. They were normally grazed between 1000h and 0130h daily and watered after grazing. Supplemented feed at 0.25kg per animal was fed to the animals. Prior to the commencement of the experiment, they were dewormed with Levadex injection (Pantex Holland B.V.) at a dose of 1ml per 50kg and coccidiostat treatments were administered for 3days. They were treated against trypanosomiasis with Dimizaine aceturate (Nozomal Kepro, B.V., Holland) at
the dose of 3.5mg per kg by intramuscular injection. Oxytetrac200LA was administered at the rate of 1ml/10kg against bacterial infection. Ivomec was also administered against mange at 1ml/50kg. They were also vaccinated against Peste des Petites Ruminants (PPR) using Tissue Cultures Rinderpest Vaccine (TCRV).

The mean morning rectal temperature (RTM), mean afternoon rectal temperature (RTA), mean evening rectal temperature (RTE), mean morning respiratory rate (RRM), mean afternoon respiratory rate (RRA), mean evening respiratory rate (RRE), mean morning pulse rate (PRM), mean afternoon pulse rate (PRA) and mean evening pulse rate (PRE) of Yankasa and West African Dwarf Sheep were taken on Fridays at 0700h, 1230h and 1730h every week for a period of 5 weeks. Sheep were easily caught for measurement. Two independent counts of the respiratory (flank) movements were made and averaged to per minute measurements. This was done before the rectal temperature was taken to avoid excitement. A stopwatch was used to time the counts of the flanks. The rectal temperature was taken Mercury-In-Glass clinical thermometer which was inserted into the rectum of the animal at a depth of 5cm with the bulb touching the mucosa wall of the rectum for two minutes. It was removed and read. The thermometer was then cleaned with methylated spirit and jerked to bring the mercury level down before further use, while the pulse rates were taken from the femoral artery. Mean, Standard error of mean and Student’s t-test were conducted using Statistical Package for Social Sciences on computer.

The results are presented in Figures 1 and 2. Meteorological data during the study period showed that during the hot rainy season, the environment was characterized by a high ambient temperature (31.3±0.3 OC) and high humidity (97.0±1.0%). The mean rainfall was (66.3±6.8mm). The RTM (mean morning rectal temperature), RTA (mean afternoon rectal temperature), RTE (mean evening rectal temperature) of YK were 38.7±0.01OC, 39.1±0.01 OC, 39.3±0.01 OC and WAD were 38.9±0.1 OC, 39.3±0.01 OC and 39.5±0.01 OC respectively. The RRM (mean morning respiratory rate), RRA (mean afternoon respiratory rate), RRE (mean evening respiratory rate) of YK were 38.0±2.4, 48.7±2.6, 52.2±2.5 breaths/minute and that
of WAD were $44.9\pm 2.3$, $60.1\pm 2.9$ and $60.1\pm 2.8$ respectively while the PRM (mean morning pulse rate), PRA (mean afternoon pulse rate) and PRE (mean evening pulse rate) of YK were $59.7\pm 2.2$, $67.5 \pm 2.0$ and $70.3 \pm 2.1$ and that of WAD were $63.3 \pm 2.0$, $71.1 \pm 2.0$ and $72.9 \pm 1.8$ beats/minute. All the physiological parameters were higher in the WAD than the YK. The rectal, respiratory rate and pulse rate of these two breeds rose concurrently with the hour of the day. Figures 1 and 2. This agrees with the findings of Fayomi et al.⁴ and those of Ayo and Minka⁵. The physiological parameters obtained in this study were lower than that reported by Fayomi et al.⁷.

It is concluded that the two breeds were both not stressed during the early rainy season and can perform very well in the forest zone of Nigeria and Yankasa breed can easily adapt to the forest zone. However, additional stress should be avoided or minimized to reduce the risk of adverse effects on these breeds particularly Yankasa breed which is not widely reared in the forest zone.

References


Received for publication on 25th October, 2006.
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'industry animale et une meilleure utilisation des ressources du bétail en Afrique. Le Bulletin est un périodique trimestriel.

Présentation des articles

Un article ne peut être soumis pour publication que s'il n'a pas encore été proposé ailleurs; il fera l'objet de révision 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:
Chaque ligne du texte doit être numérotée.
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 plusieurs fois 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).

Brève communication
Une brève communication signifie que l'article ne peut pas être publié comme une communication normale. Elle ne doit pas dépasser deux pages imprimées ou 1000 mots en incluant deux illustrations au maximum. Elle doit donc respecter les mêmes normes qu'un article habituel, sauf que le résumé et les sous-titres ne sont pas nécessaires.

Epreuves typographiques
Les épreuves typographiques sont envoyées à l'auteur qui en effectue la correction des coquilles et en assure le retour rapide (dans les 3 jours).

Tirés à part
25 tirés à part de chaque article sont fournis gratuitement. Il est possible de commander des tirés à part supplémentaires et les payer au moment des épreuves typographiques. Le coût d'un tiré à part supplémentaire s'élève à 2 SEU.

Abonnements
Le coût de l'abonnement annuel y compris le tarif d'affranchissement (par voie terrestre) et le frais de manutention, est de 50 SEU. L'envoi par avion est possible sur simple demande.

Anciens numéros
Il est également possible de se procurer, sur simple demande, les anciens numéros aux mêmes prix.