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BULLETIN OF ANIMAL HEALTH AND PRODUCTION IN AFRICA**VOL 59 NO. 2****CONTENTS****JUNE 2011****ORIGINAL ARTICLES**

	Pages
1 Small Ruminants Trypanosomosis in Western Gojam Zone of Amhara Regional State, Northwestern Ethiopia. <i>Kebede G, Degefu H, Yohannes M and Tolosa T</i>	123
2 Prevalence and associated risk factors of bovine mastitis in local and cross breed dairy cows in and around Jimma town. <i>Tigre W, Wakwoya A, Regassa F and Tolosa Tadele</i>	129
3 Local Poultry Farmers' Media Use, Access and Understanding of Highly Pathogenic Avian Influenza Communication Materials in Nigeria. <i>Assam A, Abdu P A and Tabe-Ntui L N</i>	137
4 Studies on parasitic gastroenteritis in sheep. <i>Farid Fouad Moustafa Salem, Mohamed Moustafa Abd-El-Samea and Mohamed Nagi Sleem EL-Sheary</i>	149
5 A Survey of <i>Schistosoma Bovis</i> in cattle in Kwale District Kenya. <i>Kamanja IT, Githigia S M, Muchemi G M and Mwandawiro C</i>	161
6 Epidemiological Studies on Bovine Babesiosis. <i>Salm F F, Younis E E, Hegazy N M and El-Sawalhy A A</i>	169
7 Epidemiological Studies on Bovine Anaplasmosis. <i>Salm F F, Younis E E, Hegazy N M and El-Sawalhy A A</i>	179
8 Prevalence of Enzootic Bovine Leukosis (EBL) in the Northern Somalia. <i>Yasser M Ghanem, Mohamed S Ahmed and Ahemd H. Abdelkader</i>	190
9 <i>Etat de la Trypanosomose chez les bovins N'dama et évaluation de l'utilisation des trypanocides dans la zone cotonnière de la Haute Guinée (Guinée - Conakry)</i> <i>Barry A M and Vial L</i>	199
10 Haematological, Carcass Characteristics and Meat Quality of Intensively Managed West African Dwarf Goats Slaughtered at Different Live Weights. <i>Fasae O A, Ibikunle B A, Oyeniya O A and Adu I F</i>	208
11 <i>Study on Gross Testicular Abnormalities of Rams and Bucks at Luna Export Abattoir, Modjo, Ethiopia.</i> <i>Hailemariam S, Nigusie Z, Tolosa Tadele and Regasa F</i>	216
12 Studies on some Reproductive Parameters of the Grasscutter (<i>Thryonomys Swinderianus</i>) in South - West Nigeria. <i>Fadeyi O A, Ajala O O, Obudu C E and Nafarnda W D</i>	222
13 Factors Influencing Conception Rates of Cameroonian Zebu Cattle (<i>Bos Indicus</i>) Following Oestrus Synchronisation and Artificial Insemination. <i>Kamga-Waladjo A R, Tebug S F, Keambouc T C, Ndambid O A, Ndukume J A and Thiam O</i>	227
14 Beak Amputation Effects on Performance and Egg Quality Characteristics of Native Layers (Yacon) Chickens. <i>Abiola S S, Balogun J S, Oduguwa O O and Dipeolu M A</i>	233
15 Etude Comparee des Caracteristiques de Ponte de La Poule Camerounaise (<i>Gallus Gallus</i>) et D'un Label. <i>Fotsa J C, Poné Kamdem D, Rognon X, Tixier-Boichard M, Meffeja, Tchoumboué J, Manjeli Y and Bordas A</i>	239
16 Potential for Using Multinutrient Block for Supplementing Feeding of Growing Goats During Dry Season in Cameroon. <i>Tendonkeng F, Boukila B, and Pamo T E</i>	252

- 17 Composition Botanique du Régime des Dromadaires et Valeurs Alimentaires des Plantes Ingerées Sur un Parcours Aride du Niger. *Chaibou M, Faye B, and Vias G*..... 259

SHORT COMMUNICATION

- 18 Serological Survey of Newcastle Disease Status in Village Chicken in The Bamenda Highlands of Cameroon. *Nfi A N, Ekue F N, Pone D K, Mafeni J M, Nji-Mbua Colette, Tih Shiffe*..... 274
- 19 Sondage Serologique sur les Maladies Transmises par les Tiques Chez les Bovins N'dama en Guinee. *Barry A M and Keita S*..... 277

SMALL RUMINANTS TRYPANOSOMOSIS IN WESTERN GOJAM ZONE OF AMHARA REGIONAL STATE, NORTHWESTERN ETHIOPIA

Kebede G¹, Degefu H¹, Yohannes M¹ and Tolosa T^{1*}

¹Jimma University, Collage of Agriculture and Veterinary Medicine, P.O.Box 307, Jimma, Ethiopia

Summary

A cross sectional study in small ruminant trypanosomosis was carried out in Dembecha and Jabitehnan districts of Northwestern Ethiopia to determine prevalence of trypanosomes infection in randomly selected sheep and goats from October 2008 to May 2009. Blood samples were collected from the marginal ear vein of 400 animals (256 sheep and 144 goats), the samples were checked for trypanosomes by Buffy coat –dark ground microscopic technique and Gemsa stain while heamatocrit centrifugation techniques were used to determine packed cell volume (PCV). Out of the examined small ruminants 25(6.3%) were found to be infected with one or more species of trypanosomes. There was no statistically significant difference ($P > 0.05$) in the prevalence of trypanosomosis among small ruminants from different localities. The infection was higher in sheep (7.8%) than goats (3.5%). The overall infection rates for male and female ruminants were 8.9% and 1.9%, respectively, and there was statistically significant difference between two sexes ($P < 0.05$). There was no significance variation in the prevalence of trypanosome infection among the different age groups of small ruminants. *T. Congolese* was the dominant trypanosome investigated. The mean PCV values of infected sheep and goats were lower than the Mean PCV values of non infected animals. The relatively high infection rates recorded and the low PCV value observed in this study are indicatives of the importance of small ruminant trypanosomosis in the area.

Keywords: Small ruminants, Prevalence, Trypanosomosis, Western Gojam, Northwestern Ethiopia

TRYPANOSOMOSE ANIMALE CHEZ LES PETITS RUMINANTS DE LA REGION DU GOJAM OCCIDENTAL (ETAT DE L'AMHARA), AU NORD-OUEST DE L'ETHIOPIE

Résumé

Une étude intersectorielle sur la trypanosomose animale chez les petits ruminants a été réalisée dans les districts de Dembecha et Jabitehnan du Nord-ouest de l'Ethiopie aux fins de détermination de la prévalence de l'infection par les trypanosomes chez les ovins et caprins sélectionnés de manière aléatoire entre octobre 2008 et mai 2009. Des échantillons de sang ont été prélevés de la veine marginale de l'oreille de 400 animaux (256 ovins et 144 caprins). Les tests de prévalence de la trypanosomose ont été effectués à l'aide de la technique microscopique de la couche leucocytaire et des frottis minces avec coloration de Giemsa, alors que pour la détermination de l'hématocrite, l'on a eu recours aux techniques de centrifugation de l'hématocrite. Au terme de l'examen de l'ensemble des petits ruminants, il s'est trouvé que 25 animaux (soit 6,3%) sont infectés par une ou plusieurs espèces de trypanosomes. Sur la base des données statistiques, Il n'y avait, s'agissant de la prévalence de la trypanosomose, aucune différence significative ($p > 0,05$) parmi les petits ruminants des différentes localités. L'infection était plus élevée chez les ovins (7,8%) que chez les caprins (3,5%). Les taux généraux d'infection pour les ruminants mâles et femelles étaient respectivement de 8,9% et 1,9%, et il y avait, au niveau des données statistiques, des différences notoires de l'ordre de ($p < 0,05$) entre les deux sexes. En matière de prévalence de l'infection à trypanosome entre les différents groupes d'âge des petits ruminants, aucune variation importante

*Corresponding author: tadeletolosa@yahoo.com

n'a été notée. L'essentiel des travaux de recherche portait sur la prévalence de *Trypanosoma Congolensis*. Les valeurs moyennes de l'hématocrite des ovins et des caprins infectés étaient inférieures aux valeurs moyennes de l'hématocrite des animaux non infectés. Les taux d'infection relativement élevés et la faible valeur de l'hématocrite qui ont été relevés au courant de cette étude servent d'indicateurs concrets du niveau important de prévalence de la trypanosomose animale chez les petits ruminants dans la région.

Mots-clés: Petits ruminants ; prévalence ; trypanosomose ; Godjam occidental, Nord-ouest de l'Éthiopie

Introduction

Sheep and goats are a major component of the livestock production system in many parts of Ethiopia. They serve as a source of cash to pay for school fees for children, and purchase of goods for family consumption and also serve as a source of protein and animal predominantly slaughtered during festive and religious occasions (ILCA, 1993). However, the production and productivity of sheep and goats are low due to various diseases. Among them is Trypanosomosis causes constraints in health and production losses in small ruminants. Some experimental and natural infection studies on small ruminant trypanosomosis showed the disease could have an adverse effect on health and productivity of sheep and goats (Griffin and Allonby, 1979; Dinka and Getachew, 2005; Yanan *et al.*, 2007; Batista Oliveira *et al.*, 2009). Hematological changes such as, anemia, reduced packed cell volmes (PCV) value and reduced hemoglobin level were the major abnormalities recorded in small ruminant trypanosomosis. Weight loss, abortion and still birth were also recorded in experimental infection in sheep and goats (Batista *et al.*, 2006). The role of small ruminants as reservoirs in livestock trypanosomosis in general was also considered by researchers (Gutierrez *et al.*, 2006; Batista Oliveira *et al.*, 2009).

In Ethiopia, a total of 6.12 million sheep and goats are at risk of contracting trypanosomosis (MOA, 1995). Reports by Dinka and Getachew (2005), Keno (2005) and Nigatu *et al.*, (2009) reported an overall prevalence of 5.1%, 0.6% and

5%-7% for small ruminant trypanosomosis, respectively, in some areas of southwest and northwestern Ethiopia respectively. Generally, trypanosomosis in small ruminant has not been well addressed as emphasis is always given to bovine in this country. There is no published information on of small ruminant trypanosomosis in the study area. Thus, this study was undertaken to determine the prevalence of small ruminant trypanosomosis and assess the effect of trypanosome infection in packed cell value of sheep and goats.

Materials and Methods

Description of the study Area and Population

The study was conducted from October 2008 to May 2009 in Demebecha and Jabitehnan districts of West Gojjam Zone (100 30' N and 370 29' E) in Amhara Regional State of Northwest Ethiopia. The climate has long summer rainfall (June-September) with winter dry season (December-March) with mean annual rainfall of 1200-1600 mm. The mean temperature lay between 10-20°C and the altitude ranges from 1400-2300 m. Temechan and Bir tributaries in West Gojjam Zone join before entering the main river Abay (Blue Nile) bordering the study villages. Ponds and marshy areas are also found in the lowland areas of the study area. The five different vegetation types namely savanna grassland, forest, riverine and bush land along with the recently expanded cultivated lands are found. These different vegetation types are mainly found in areas below 1700 m whereas above this altitude the land is occupied by cultivated lands and small areas left for grazing purposes.

Study design

The study was conducted on 400 local breed animals (256 sheep and 144 goats). The animals were selected randomly regardless of their sex and age, and then each selected animal's age, sex, species and locality (village names) were recorded before taking blood sample. The age of animals was determined by dentition, then categorized as young (≤ 1 year, no permanent teeth) and adult (> 1 years).

Parasitological and Hematological Survey

Blood was collected from the marginal ear veins of selected small ruminants using a lancet in heparinized capillary tube (microhaematocrit tubes) up to $\frac{3}{4}$ th of its volume. The tubes were sealed using a sealant, placed in a centrifuge, and spun at 12000 rpm for 5 minutes to separate the red blood cells from the plasma, and to concentrate the trypanosomes. The microhaematocrit were then placed on a PCV reader and the packed cell volume was read and recorded. Animal with PCV below 24 were considered as anemic (for sheep) and below 22 for goats (Radostits *et al.*, 2000).

The trypanosomes infection was detected by the method of blood examination using Buffy-coat dark ground microscopic techniques. For each positive cases Giemsa stained blood smear was made for species of trypanosome identification morphologically by their size, shape, location and size of kinetoplast, position of nucleus and the attachment and length of flagellum (Losos, 1986). The total sample taken, total PCV and prevalence were recorded for each particular locality, district and at the end the overall prevalence of trypanosome infection was calculated as proportion of positives among sampled animals.

Data analysis

Data on individual animals were coded in to MS Excel spreadsheets program to create a database and STATA version 11 software was used for the

analysis and interpretation of the data. The prevalence of trypanosomosis in different variables (localities, species, sex and age) was compared with the Chi square test. Student's t-test was used to compare the mean PCV values of parasitemic and aparasitemic animals. P-values less than or equal to 0.05 were considered as statically significant.

Table 1: Over all prevalence of small ruminant trypanosomosis across the study villages

localities	Total examined	Positive animals (%)	95% CI
Woynima	82	0 (0)	0
Erigib	129	12(9.3)	9.3 \pm 0.05
Melkach-aba	100	7(7)	7.0 \pm 0.03
Yengilal	89	6(6.7)	6.7 \pm 0.01
Total	400	25(6.3)	6.3 \pm 0.01

$\chi^2 = 7.6$, Df = 3, $p > 0.05$

Results

Prevalence

Out of 400 animals examined, 25 (6.3%) were infected with trypanosomes by using the Buffy coat technique. A significantly higher prevalence of infection was recorded in sheep (7.8%) than goat (3.5%) (Table 2). There was no statistically significant variation observed in the prevalence of trypanosomosis among the different localities in the study, the highest record at Ergib (9.3%) and a none at Woynima (Table 1)

Effect of sex and age on prevalence of small ruminant trypanosomosis

There was a statistically significant difference observed in the overall prevalence between female (8.9%) and male (1.9%) sampled animals (Table 2). No significance variation ($P > 0.05$) was not observed in the overall prevalence of trypanosome infection among young and adult age groups (Table 2).

Table 2: Prevalence of trypanosomosis in different sex, age and species group small ruminants

Parameters	Group	No animals examined	Positive animals (%)	95% CI	X2	p value
Sex	Female	246	22(8.9)	8.86-8.94	7.9	0.005
	Male	154	3(1.9)	1.88-1.92		
Age	Young	67	2 (2.9)	2.86-2.94	1.4	0.226
	Adult	333	23 (6.9)	6.87-6.93		
Specie	Ovine	256	20(7.8)	7.77-7.83	3.4	0.065
	Caprine	144	5(3.5)	3.47-3.53		

Table 3: Infection rates of trypanosome species in sheep and goats

SPP of animals	No of animals	Species of trypanosomes		
		T. congolense (%)	T. vivax (%)	Mixed (T.vivax & T.brucei)(%)
Sheep	256	11(55)	7(35)	2(10)
Goats	144	5(100)	0	0
Total	400	16 (64)	7(28)	2 (8)

Table 4: Mean PCV values compared in infected and non-infected sheep and goats

Species	Condition	No .animals	Mean PCV (%)	CI (95%)	T-value	P-value
Sheep	Parasitaemic	20	20.3	18.2-22.4	4.6	P< 0.05
	Aparasitemic	236	25.2	24.6-25.8		
Goat	Parasitaemic	5	20.8	14.1-27.4	-1.2	P< 0.05
	Aparasitemic	139	25.0	23.3-24.7		

Prevalence of Trypanosomes Species

Trypanosoma Congolense (64%) was the major trypanosome species involved in the infection and was also the only trypanosome species identified in the infected goats during the study period (Table 3).

Analysis of the Packed Cell volume values

The mean PCV for non-infected sheep and goats were 25.2% and 25%, respectively, while the mean PCV values for infected sheep and goats were 20.3% and 20.8% respectively (Table 4). The mean PVC between infected and non infected sheep herds showed statistical significance variations but not in the case of goats.

Discussions

The overall prevalence of

trypanosomosis recorded in small ruminant in this study was slightly higher than the previous reports (Dinka and Getachew, 2005; Nigatu *et al.*, 2009) in Southwestern and Northwestern Ethiopia. This finding is in line with the report of Keno (2005) but it is lower than the prevalence reported in Kenya by Ng'ayo *et al.*, (2005). The highest prevalence of trypanosomosis in small ruminants was seen in Eirgib (9.3%) and none (0%) in Woynema locality. Nevertheless, there was no significant difference in trypanosome prevalence seen between localities ($P > 0.05$).

No statistically significant differences in trypanosome prevalence was found between sheep and goats during the study period, but the proportion of infection rate was higher in sheep (7.8%) than goat (3.5%). This finding is consistent with the findings of Dinka and Getachew (2005) in this country, Ameen *et al.*, (2008) in Nigeria and Osaer

et al., (1999) in Gambia. The low infection rate in goats can be associated with the avoidance behavior of flies as suggested by Snow et al. (1996). On the other hand, Murray et al., (1985) described that *Glossina* flies may select other livestock over goat when mixed animal populations there are.

A significant difference ($p < 0.05$) in the overall prevalence of trypanosomosis was found between male (1.9%) and female (8.9%) small ruminants. This observation is similar with the earlier reports of by Daniel et al., (1994) and Samdi et al., (2008) in Nigeria. However, it differs from the report of Dinka and Getachew (2005) from the southwest Ethiopia.

The higher prevalence (6.9%) observed in adult animal as compared with young ones (2.9%) in this study is not in agreement with the findings of previous report (Dinka and Getachew, 2005). However, Bealby et al. (1996) in Zambia and Osaer et al., (1999) in Gambia had reported similar cases. Young animals are less exposed to the disease due to lack of long association with the vectors of trypanosomosis (Bealby et al., 1996).

This investigation revealed that *T. congolense*, *T. vivax* and *T. brucei* were the trypanosomes infecting small ruminants in the study sites. The results substantiate earlier documented reports (Dinka and Getachew, 2005; Nigatu et al., 2009). Shimeles et al., (2005) have also reported the same species of trypanosomes on bovine trypanosomosis in the study sites. *T. brucei* had the lowest prevalence and *T. congolense* was the only trypanosome detected in goats during the study period. There were no comparable similar findings reported in Ethiopia. However, Ameen et al., (2008) have reported that all the positive trypanosome infections in the small ruminants were due to *T. congolense* in Nigeria.

Although it was observed that the PCV levels of both trypanosome infected species of animals were lower when compared with non infected animals, statistically significant variation ($P < 0.05$)

was observed only in sheep. Anemia is the classical symptom of the disease pathogenicity, the low PCV in infected animals could have contributed in reducing the mean PCV for small ruminants (Murray and Dexter, 1988).

Conclusion

The high prevalence and low packed cell volume (PCV) recorded in trypanosome infected sheep and goats are a clear indications of the importance of the disease in the districts of Dembecha and Jabitehnan in the North west of Ethiopia. Furthermore, the finding of three species of trypanosomes: *T. congolense*, *T. vivax* and *T. brucei* in the blood of infected animals implies that sheep and goats of the area can be reservoirs in the transmission dynamics of bovine trypanosomosis, which is a very important disease in the area. Therefore, further studies should be initiated on how small ruminants can be considered in any control program of bovine trypanosomosis in the country.

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PREVALENCE AND ASSOCIATED RISK FACTORS OF BOVINE MASTITIS IN LOCAL AND CROSS BREED DAIRY COWS IN AND AROUND JIMMA TOWN

Tigre W, Wakwoya A, Regassa F and Tolosa Tadele.*

Jimma University, College of Agriculture and Veterinary Medicine, P.O. Box 307, Jimma, Ethiopia

Summary

A cross sectional study was conducted on local and cross bred dairy cows in Jimma town and its surroundings to determine the prevalence of mastitis and potential risk factors. Simple random sampling of dairy herds, clinical examination of udder and milk and udder test card were used. Of the total dairy cows examined (N=387), 36.69% (n=142) of them were found to be positive for either clinical or sub clinical mastitis. Clinical and sub clinical mastitis were found to be 7.75% (n=30) and 28.94% (n=112), respectively. Factors significantly associated with mastitis were, lactation stage ($\chi^2 = 38.85, P < 0.01$), parity ($\chi^2 = 13.70, P < 0.01$), body condition score (BCS) of the dairy cows ($\chi^2 = 11.9, P < 0.01$) and herd size ($\chi^2 = 7.23, P < 0.05$). The breed of the animals was not significantly associated with mastitis ($\chi^2 = 1.35, P > 0.05$).

Key words: Jimma and its surroundings, local and crossbred dairy cows, mastitis, Risk factors.

PRÉVALENCE ET FACTEURS DE RISQUE ASSOCIÉS DE MAMMITE BOVINE CHEZ LES VACHES LAITIÈRES LOCALES ET CROISÉES DE LA VILLE DE JIMMA ET SES ENVIRONS

Résumé

Une étude intersectorielle a été réalisée sur les vaches laitières locales et croisées de la ville de Jimma et ses environs en vue de déterminer la prévalence de la mammite et des facteurs éventuels de risque associés. L'on a eu recours, tour à tour, au simple échantillonnage aléatoire de troupeaux de vaches laitières, à l'analyse clinique des mamelles et du lait et aux cartes de dépistage mammaire. Sur l'ensemble des 387 vaches laitières examinées, 142 (36,69%) ont été trouvées positives soit à la mammite clinique soit la mammite sous-clinique. Les cas de mammite clinique recensés ont été de 30 têtes soit 7,75%, contre 112 cas de mammite sous-clinique (28,94%), respectivement. Les facteurs pratiquement infaillibles associés à la mammite sont le stade de lactation, ($\chi^2 = 38.85, P < 0.01$), la parité ($\chi^2 = 13.70, P < 0.01$), la note d'état corporel (NEC) des vaches laitières ($\chi^2 = 11.9, P < 0.01$) et la taille du troupeau ($\chi^2 = 7.23, P < 0.05$). Il n'y a eu aucun rapprochement important entre la race des animaux et la mammite ($\chi^2 = 1.35, P > 0.05$).

Mots clés: La ville de Jimma et ses environs, les vaches laitières locales et croisées, la mammite, les facteurs de risque.

* Corresponding author e-mail: tadeletolosa@yahoo.com

Introduction

Mastitis is an inflammation of the mammary glands of dairy cows characterized by physical, chemical, pathological and bacteriological changes in milk and pathological changes in glandular tissue (Radostitis *et al.*, 2000). Bovine mastitis is of great economic importance to the dairy industry; due to reduced milk yields, increased culling rates, treatment costs, and occasionally death from severe infections (Radostitis *et al.*, 2000) and thus, is a disease that can cause devastating effects to a farmer because of serious economic losses (Ameh *et al.*, 1999).

Despite many years of research, mastitis remains the most economically damaging disease for dairy industry worldwide irrespective of species of animal (Owens *et al.*, 1997). Bovine mastitis is known to be a problem in Ethiopian dairy herds in both local and crossbred animals (Abaineh and Sintayehu, 2001; Seyoum *et al.*, 2003; Kerro and Tareke, 2003; Lakew *et al.*, 2009; Tolosa *et al.*, 2009). In Ethiopia, high prevalence of bovine mastitis has been reported in Modjo 79 % (Alemnew, 1999), Dire Dawa and Eastern Harerghe Zone 80.2% (Sibhat, 1997), South Wollo 57.5% (Haile, 1995) and Wolayta Soddo 54.4% (Biffa, 1994). Moreover, relatively lower prevalence of mastitis has been reported from other parts of Ethiopia such as around Bedelle 15.25% (Tsegai, 1991), in Southern Ethiopia 34.9% (Biffa *et al.*, 2005) and around Sebeta 36.67% (Sori *et al.*, 2005).

Knowledge of the types and extent of common health problems and their association with different risk factors is important to livestock owners, extension agents, veterinarians and researchers, and can assist in the development of herd health strategies and the selection of possible intervention options (Radostitis *et al.*, 2000). In Ethiopia, even though mastitis has been studied, there are no studies on prevalence and associated risk factors in the Jimma area. The objectives of this study were

therefore, to determine the prevalence of mastitis in local and crossbred dairy cows in and around Jimma town and to assess the associated risk factors.

Materials and Methods

Study site

The study was conducted in Jimma town and its surroundings, Jimma zone, Southwestern part of Ethiopia. Jimma town, the capital of Jimma zone is located in Oromia Regional State, at 346 kilometers Southwest of Addis Ababa at latitude of about 7°13'-8°56' N and longitude of about 35°52'-37°37' E, and at an elevation ranging from 880 m to 3360 m above sea level. The annual rainfall of the zone is 1637 mm in average and the temperature ranges from 11.43°C to 26.2°C mean minimum and maximum annual temperatures, respectively. The study area has bimodal pattern of rainfall with a general feature of short and long rainy seasons.

Study Design

A cross sectional study design was used to determine the prevalence and assess the major risk factors associated with mastitis in lactating dairy cows from October 2007 to April 2008.

Study farms and animals

In the study, 184 local and 203 crossbred dairy cattle from different production systems in Jimma town and its surroundings were used. The 150 farms of local and 50 farms of crossbred included in the study were selected by random sampling method in local and all lactating dairy cattle in crossbred farm were included in the study.

Data collection

Questionnaire survey, clinical examination of milk and udder and udder test card were used to conduct the study. A pre-designed semi-structured questionnaire was administered to farm owners or attendants/

farm managers to obtain herd based and individual animal based information. Important information about the herd and individual animal was recorded. The udder of the animal was washed with water and dried with appropriate cloth. All quarters were clinically examined for abnormalities in size, consistency and any inflammatory signs by visualization of udder and milk and palpation of the udder. Swelling of udder, pain reaction during palpation, change in consistency and color of milk were considered and registered as indicators of clinical mastitis. Finally, a couple drops of milk from all quarters of the dairy cattle included in the study was added on the respective spots of udder test card/indicator paper and those that changed the spots of the paper from yellow to green or bluish green were interpreted and recorded as positive results (sub clinical mastitis), while those with no change of the color of the spots were considered as negative results.

Data analysis

The prevalence of mastitis was determined as the proportion of affected animals out of total cows examined. Possible risk factors such as breed, lactation number (parity), body condition score (Nicholson and Butterworth, 1986), management system (local or cross), production system (intensive or extensive), lactation stage and herd size were considered during analysis. The association of each of these risk factors and the prevalence of mastitis were determined using chi-square (χ^2) test. In all the analysis, confidence level was held at 95% and $P < 0.05$ was set for significance.

Results

A total of 387 dairy cows from different farms with different production systems were examined. Of the total dairy cows examined, in 36.69% ($n=142$) of them at least one teat found to be affected either with clinical or sub clinical mastitis. Higher prevalence of sub clinical mastitis (28.94%

($n=112$) was found than that of clinical mastitis (7.75%) ($n = 30$) (Table 1) and this difference was statistically significant.

Statistically, significant association ($\chi^2 = 38.85, P < 0.05$) of prevalence of mastitis and lactation stages of the dairy cattle was observed. The prevalence of mastitis was found to be highest, 50.00% in dairy cattle in their early lactation than in those in their mid (42.96%) and late lactation (13.79%) stages. Parity was significantly ($\chi^2 = 13.70, P < 0.05$) associated with the prevalence of mastitis in dairy herds in the study area. Higher prevalence was obtained in pluripara cows, 40.39% ($n = 124$) than in primipara heifers, 22.50% ($n=18$). Significantly ($\chi^2 = 11.90, P < 0.05$), higher prevalence of mastitis was observed in lean (L) animals, 50% ($n=28$), followed by medium (M) animals, 41.46% ($n=68$) than in animal with good body condition score, 27.54% ($n=46$). An attempt was also made to investigate prevalence of mastitis in dairy cows kept in different herd sizes. Considerably, high prevalence was obtained in larger herds with greater than or equal to 10 animals, 42.47% ($n=93$) than in herd size with less than 10 animals, 29.17% ($n=49$). Though statistically not significant crossbred dairy cows were observed to be more susceptible to mastitis (39.41%) than the local animals/zebus (33.70%) (Table 2).

Discussion

The overall prevalence of bovine mastitis obtained in this study is in agreement with previous findings (Deresema, 1991; Fikadu, 1995) in Eastern and Northern parts of Ethiopia, respectively. Several previous workers in different parts of Ethiopia (Biru, 1989; Aregawi, 1992; Tolla, 1996; Zerihun, 1996; Sori *et al.*, 2005; Lakew *et al.*, 2009) also reported higher prevalence of bovine mastitis. It has been suggested that the differences in the prevalence of bovine mastitis in dairy farms could be associated with various factors like climatic conditions, breed and level of production of the study animal and management practices (Bartlett

Table 1: Prevalence of clinical and sub-clinical mastitis in local and cross breed dairy cows in and around Jimma town.

Mastitis	Total number of animals examined	Number of animals affected	Percent affected
Clinical Mastitis	387	30	7.75
Sub-clinical Mastitis	357	112	28.94
Total	387	142	36.69

Table 2: A summary of prevalence of mastitis and its association with potential risk factors in local and cross breed dairy cows in and around Jimma town.

Variable	Number of animals examined	Number of animals affected	Percent affected	X ²	P-value
Lactation stage					
1 – 4 months	136	68	50.00		
5 – 6 months	135	58	42.96	38.85	P < 0.01
> 7th months	116	16	13.79		
Parity					
1st	80	18	22.50		
2nd	132	44	33.33	13.70	P < 0.01
> 3rd	175	80	45.71		
Body Condition Score					
Lean	56	28	50.00		
Medium	164	68	41.46	11.90	P < 0.01
Fat	167	46	27.54		
Herd Size					
< 10	168	49	29.17		
10- 20	101	43	42.57	7.23	P < 0.05
> 20	118	50	42.37		
Breed					
Local/Zebu	184	62	33.70	1.35	P > 0.05
Cross	123	80	39.41		

et al., 1991; Lakew *et al.*, 2009).

In this study, the contribution of clinical and sub-clinical mastitis was 7.75% and 28.94%, respectively. A lower prevalence of clinical mastitis of 4.2% has been reported in Italy (Giovannini *et al.*, 2000). Slightly higher prevalence of clinical mastitis 15.1%, 11.9% and 16.11%, have also been reported (Biffa, 1994; Biffa *et al.*, 2005; Sori *et al.*, 2005) in central and Southern parts of Ethiopia. The share of sub-clinical mastitis obtained in the current study (28.94% on cow basis) was in

agreement with the findings (Ayalew, 1998) in central Ethiopia, in Mekelle (Wudu, 1999) and in Southern part of Ethiopia (Biffa *et al.*, 2005).

The current study showed highest prevalence of mastitis in cows in early lactation as compared with those in mid and late lactation and this was in agreement with previous reports (Kehrli and Shuster, 1994; Biffa *et al.*, 2005). Absence of dry cow therapy and the conducive nature of dry period that allow pathogens to penetrate

into the teat canal and multiplication and thus, carried over into the immediate post-parturient mastitis/clinical mastitis could be among the major factors contributing to high prevalence of mastitis during early lactation stage (Radostits *et al.*, 2000). The dry period secretion has been reported to inhibit phagocytic action of neutrophils in the udder and during dry period, the capacity of the quarters to provide phagocytic and bactericidal activities diminished which in turn could lead to high infection rate (Schalm *et al.*, 1971).

The association between the prevalence of mastitis and parity of the dairy cows as observed in this study was in agreement with previous findings where increased incidence of infected quarters was associated with cows greater than 7 years of age (Smith, 1996). High prevalence of mastitis with increasing lactation number and age of cows has also been documented (Quinn *et al.*, 1994; Biffa *et al.*, 2005).

The infection rate of mastitis was found to be higher in lean animals (50 %) than in medium (41.46%) and animals with fat (27.54%) body condition scores. Animals in poor body condition may have poor defense mechanism and thus are susceptible to several diseases including mastitis.

High prevalence of bovine mastitis was found in herds with greater than or equal to 10 animals which comprised 42.47% of the studied herds than in herd with less than 10 animals comprising 29.17% of the studied herds and this was in accordance with previous observations (Radostits *et al.*, 2000) who found high prevalence of bovine mastitis in large herds than in small herd sizes. High occurrence of the diseases was recorded in intensively managed dairy cattle accompanied by poor management/sanitation practices. Poor hygienic status of animal keeping and milking processes such as absence of improper udder washing, milking cows with common milkers and using common udder cloths when coupled with increased herd size facilitate the spread of the pathogens (Radostits *et al.*,

2000). This may be due to the fact that risk of an individual animal introduced mastitis infection into free herd may increase with herd size, and spread of infection within the herd may be favored. In contrast to previous enhanced reports who found statistically significant different prevalence of mastitis in different breeds of dairy cattle (Quinn *et al.*, 1994; Radostits *et al.*, 2000), breed based analysis indicated no significant superiority of indigenous cattle in resisting infection with mastitis. This difference might be associated with conservative way of classifying study animals into crossbred and indigenous without considering genetic origin because of poor record on animals. Moreover, the finding may be attributed by the management level in practice in the study area as farmers gave priority to exotic and their crosses than to local animals.

This study showed that mastitis was a major health problem of dairy cows in the study area. The prevalence of subclinical mastitis was about 4 times greater than the prevalence of clinical mastitis. Mastitis was more common in old aged/cows with multiple parities and in cows in early lactation and those kept in large herds. Culling of old aged cows especially those with chronic or persistent mastitis, improving the overall management practices, early detection and treatment of mastitis will reduce the incidence of mastitis. Moreover, further study on the causative agents and their drug sensitivity patterns are recommended.

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LOCAL POULTRY FARMERS' MEDIA USE, ACCESS AND UNDERSTANDING OF HIGHLY PATHOGENIC AVIAN INFLUENZA COMMUNICATION MATERIALS IN NIGERIA

Assam A¹, Abdu P A¹, Tabe-Ntui L N^{2*}

¹Department of Veterinary Surgery and Medicine, Ahmadu Bello University, Zaria

²Department Agricultural Economics and Extension, University of Calabar, Calabar.

Abstract

A two stage household based cluster sampling was conducted in Kaduna State to investigate local poultry farmers' media use, access and understanding to highly pathogenic avian influenza educational materials. Radio and television were appropriate channels for information dissemination to farmers. Television was better at articulating highly pathogenic avian influenza risk perception among farmers. National and State radios and televisions were preferred stations with news and agricultural programs being favourites. Farmers listened to radio in the morning and evening but watch television in the evening. Publication readership was low though farmers look at billboards and posters. Posters pictures were important in attracting farmers' attention. Road junctions, churches, schools and mosques were identified as appropriate locations for placing posters. Radio was an important source of highly pathogenic avian influenza information to farmers though television coverage was poor. High mortality in poultry was what farmers remembered about the highly pathogenic avian influenza radio and television program followed. Farmers' access to highly pathogenic avian influenza educational materials was poor. However, audio-visual and poster were understood better than stickers and bulletins. Highly pathogenic avian influenza message on radio and television should be revised to include disease recognition, the need for reporting sick and dead poultry. Community dialogue system should be established to improve farmers' access to highly pathogenic avian influenza materials.

Key Words: Avian influenza, Bulletins, Communication, Educational materials, Local poultry farmers.

UTILISATION DES ORGANES DE COMMUNICATION DES AVICULTEURS LOCAUX, ACQUISITION ET COMPRÉHENSION DES MATÉRIELS DE COMMUNICATION SUR LA GRIPPE AVIAIRE HAUTEMENT PATHOGÈNE AU NIGERIA

Résumé

Un sondage à deux degrés effectué au niveau des familles a été réalisé en vue de connaître l'opinion des populations rurales sur l'utilisation des organes de communication des aviculteurs locaux, sur l'acquisition et la compréhension des matériels éducatifs sur la grippe aviaire hautement pathogène. La télévision et la radio ont été les canaux jugés appropriés pour la diffusion de l'information aux agriculteurs. De l'avis de plusieurs, la télévision est l'organe de communication le mieux approprié pour présenter clairement aux paysans le risque inhérent à la grippe aviaire hautement pathogène. Les chaînes de radio et de télévision nationales et des Etats sont les organes de communication préférés en raison de leurs grilles de nouvelles et des programmes agricoles qui privilégient le monde rural. Les populations rurales écoutent la radio le matin et le soir, mais ne peuvent regarder la télévision que dans la soirée. Peu nombreux sont ceux qui consacrent leur temps à la lecture des publications, même si les paysans regardent les panneaux publicitaires et les affiches. Les photos et les messages figurant sur les affiches jouent un rôle important dans

*Corresponding author: manassam@yahoo.co.uk

l'attraction de l'attention de la population du monde rural. Les carrefours, les églises, les écoles et les mosquées constituent des endroits appropriés pour la pose des affiches. La radio est une importante source de diffusion des informations sur la grippe aviaire hautement pathogène à l'intention des populations paysannes, contrairement à la couverture limitée des chaînes de télévision. Les paysans se souviennent effectivement de l'intérêt central accordé au programme de la mortalité élevée qui avait décimé la population aviaire, lors de la diffusion, par les chaînes de radio et de télévision, des programmes d'information sur la grippe aviaire hautement pathogène. L'accès des agriculteurs aux matériels éducatifs sur la grippe aviaire hautement pathogène est décidément dérisoire. Toutefois, les matériels éducatifs adressés par voie de l'audio-visuel et des affiches passent nettement mieux que l'utilisation des autocollants et des bulletins d'information. Les messages sur la grippe aviaire hautement pathogène diffusés par la radio et la télévision devraient être révisés en vue d'inclure la prise de conscience de la maladie, la nécessité de publier les informations sur les populations de volaille malades et mortes. Il y a lieu de mettre en place un système de dialogue communautaire censé servir de passerelle pour améliorer l'accès des paysans aux matériels d'éducation et d'information sur la grippe aviaire hautement pathogène.

Mots clés : Grippe aviaire, communication, matériels éducatifs, Volaille locale

Introduction

Local poultry (LP) forming the bulk of poultry population in Nigeria are kept in villages and peri-urban settlements in small number (Abdu *et al.*, 1999). Local poultry are the major sources of poultry meat and eggs (Abdu *et al.*, 1999). Local poultry provides extra income to its owners who are usually poorly educated with meagre resource and occasionally faced with food insecurity (Ahlers *et al.*, 2009).

In Nigeria, LP was estimated at 150 million with about three million in Kaduna state, and they make up to 90 % poultry population (RIM, 2003). Disease especially Newcastle disease (ND) has been identified amongst the constraints limiting LP production (Abdu *et al.*, 1999; Ahlers *et al.*, 2009). The little or non-existence of biosecurity offered by their management system exposes LP to continuous challenge from pathogens and environmental hazards (Abdu *et al.*, 1999). The confirmation of highly pathogenic highly pathogenic avian influenza (HPAI H5N1) in poultry in Nigeria (Joannis *et al.*, 2006) which spread to 97 local government areas (LGA) in 25 States and the Federal Capital Territory (FCT) (AICP, 2009) further increased the constraints on LP production.

Local poultry farmers being

stakeholders in the poultry industry need to be involved in measures undertaken to control and contained HPAI in Nigeria. Amongst LP farmers' expected contribution are prompt reporting of HPAI outbreaks and taking measures that would prevent its spread among poultry and reduce human exposure. These can be achieved if LP farmers have the requisite knowledge for recognition of HPAI in poultry and humans, its mode of transmission; preventive measures to reduce spread to poultry and human exposure and proper poultry handling practices (Sowath *et al.*, 2007).

Communication campaigns are aimed at educating the populace through provision of information to develop the requisite knowledge required to reduce human exposure, prevent spread in poultry and ensure reporting. For the educational materials to achieve desired behavioural change, they have to be accessed, understood and accepted by LP farmers, hence the need to identify appropriate communication channels to enhance information dissemination to farmers. This could easily be achieved with an effective extension services which is currently inadequate in most parts of Nigeria (Ejembi *et al.*, 2006). Mass media is presently the major channel of information dissemination even though many LP farmers have limited

access (Guëye, 2009) except the radio (Apantaku *et al.*, 1998; Durosilorin, 2008).

This study was conducted to investigate LP farmers' media use pattern and assess their access to and understanding of Avian Influenza Control and Pandemic Preparedness and Response Project (AICP) HPAI educational materials.

Materials and Methods

Study Area

Kaduna State is located in North Central part of Nigeria lying between latitude 8°45" and 11°30" North and longitude 6°11" and 9° East. It has 23 LGA with a population of 6 million people. The average temperature is 34°C with a rainfall of 1,000–1,500 mm. It is bordered by Kastina, Kano, Plateau, Niger, Zamfara, Bauchi, Nassarawa States and FCT. Kaduna state has an estimated poultry population of 2,821,092 with about 90% being local poultry (RIM, 2003).

The study was carried out in LGAs where a previous study revealed the presence of low pathogenic highly pathogenic avian influenza (LPAI H5N2) antibodies in LP (Duronsilorin 2008). The LGAs and villages were Ikara (Ikara town, Saban Garin Jibis and Gidan Shawai), Kachia (Nasarawa), Lere (Saminaka and Yar kasuwa), Birni Gwari (Unguwan Sarki and Unguwan Shitu), Kagarko (Sabon Garin Kagarko and Tudun Wada) and Sabon Gari (Dan Gaiya).

Sampling Method

A two stage household based cluster sampling was conducted aimed at 275 respondents – 25 persons in each of 11 villages from six LGA in Kaduna State during the months of August and September, 2009 (Bennett *et al.*, 1991). Within each village, the first household was randomly selected with subsequent household selected by proximity until 25 respondents were enrolled.

Approval was obtained from the community leader to undertake the survey and all respondents provided verbal consent.

Information on demographic, access to and understanding of some HPAI stickers, posters, bulletin and a video clip prepared by Nigeria's Highly pathogenic avian influenza Control and Human Pandemic Preparedness and Response Project (AICP); media listened to, read or watched and their preferences; their understanding and influence of HPAI information on their poultry handling practices were collected through an interview using a standardized structured questionnaire. Additional probe questions were also asked, where necessary, to shed more light on some issues raised during the administration of questionnaire.

Five posters, two stickers, a bulletin and an AICP video advert were used in assessing LP farmers' access and understanding of AICP educational materials. The video advert was played to farmers using a laptop. It discussed HPAI transmission, the need to avoid contact with poultry and seek medical attention in case of flu-like illness after contact with poultry.

An interpreter assisted in interpreting questions from English to Hausa for participants who did not understand English. Data was analyzed by descriptive statistics using SPSS version 17.0 (SPSS Inc. Chicago, IL, USA).

Results

One hundred and seventy-three respondents were interviewed and questionnaires filled with 52.6% males and 62% aged between 25–44 years. Two-third of the respondents had secondary education with 36.4% housewives and 24.9% farmers being the main occupation groups.

Fifty-two per cent of farmers listened to national radio with 42.2% listening to state radio and 2.9% do not listen to radio. Amongst those who listened to radio, 67.5% listened to news and 15.4% listened to agricultural program. There was association between the radio station farmers listened to and the program they listened with 71.2% of State radio listeners

preferring news and 12.3% agricultural program ($X^2 = 66.42$; $p = 0.01$). Males either listened to the radio alone (52.9%) or with friends (73.2%) while females listen with family (58.5%) or family and friends (60%; $X^2 = 12.10$, $p = 0.02$). Forty two per cent of farmers listened to radio in the evenings with 34.3 % preferring mornings and 12.4% listened both in the mornings and evenings. However, the most convenient time to listen to the radio was evenings for 56.2% of the farmers. Thirty-five per cent of LP farmers who listened to State (35.6%) and 46.7% National radio stations listeners favoured listening in the evenings ($X^2 = 69.65$, $p = 0.00$). Over 40 % of farmers listened alone with 31.4% listened with family and 24.3% with friends. The study revealed that farmers who listened to radio in the morning listen alone (53.4%) while those who listened in the afternoon (41.2%) listened with family members and evening listeners (36.6%) usually listened with friends ($X^2 = 48.23$, $p = 0.00$). State radio listeners (46.6%) listened alone compared to national station listeners who listened with either family (34.4%) or friends (26.7%) though generally, farmers either listened with family (31.4%) or friends (24.3%) or both (4.2%; $X^2 = 53.53$, $p = 0.00$). Farmers who listened to news listened in the morning and alone (45.6%) although those who listened to agricultural programs listened in the evenings with family members (53.8%; $X^2 = 75.21$, $p = 0.00$).

Forty-one per cent of LP farmers do not read any publication with 50.9% reading newspapers, 6.4% magazines and 1.7% reading bulletins. However, 28.3% read the publications often with only 19.7% who read very often though less than a quarter of the farmers get their publications often. Farmers read publications either in English (49.5%) or Hausa (42.7%). Among farmers who read newspapers, 47.7% get their papers often while 63.6% of magazine readers get their magazines very often ($X^2 = 178.98$, $p = 0.00$) though 45.5% of newspapers were read in either English or Hausa while 90.9% of magazines were in English. However, all

the bulletins read were in Hausa ($X^2 = 13.26$, $p = 0.04$). News (56.9%) and agriculture (37.3%) programs were the items enjoyed by farmers who read publication. News was the favourite section of 64.8 % of newspaper readers though 90.9 % who read magazines and bulletins preferred agricultural section (66.7%; $X^2 = 20.23$; $p = 0.03$).

Over three-quarter of farmers watch television (TV) with 43.4% preferring National TV and 38.7% State TV. However, 79.2% favoured news with only 18.9 % preferring agricultural programs. Seventy one per cent of the farmers watch TV in the evenings. TV was watched with either family members (42.8%) or friends (23.3%) though 34% watched alone. Farmers watching State (68.2%) and national (81.3%) TV do so in the evenings ($X^2 = 34.25$, $p = 0.00$) with 37.3 % of National and 42.4 % State (42.4%) TV viewers watching with family unlike private TV viewers who watch alone (55.6%; $X^2 = 22.79$, $p = 0.00$). News (40.9%) was the favourite program of farmers in both State (24.2%) and National (17.3%; $X^2 = 210.07$, $p = 0.00$) TV with the most convenient time to watch their favourite program being evening for State (66.7%) and National (80.0%; $X^2 = 56.33$, $p = 0.00$) TV. There was association ($p = 0.00$) between the time LP farmers watch TV and the time convenient to them with the morning being the most convenient for 75% morning viewers and 67.6% for evening viewers.

State radio listeners (54.8%) do not read any publication and 60% of National radio listeners read newspapers ($X^2 = 29.1$, $p = 0.02$). However, 40 % of farmers who do not listen to radio watch either State or National TV ($X^2 = 46.94$, $p = 0.01$).

When respondents were asked if they look at posters or billboards, Eighty-eight per cent of LP farmers look at posters and billboards. Farmers usually see the posters or billboards by the road (72.3%), school (12%) or church (11.2%). However, 93.5% of farmers were attracted to these messages because of their pictures. Farmers recommended road junctions (78.5%),

churches (6.4%) and mosques (14.0%) as the most appropriate site for placement of posters and billboards.

A relationship exists between farmers who look at posters and placement site, with posters placed at road junctions (73.2%; $X^2 = 83.62, p=0.00$). Farmers who do not look at billboards/posters recommend the mosque as ideal site for placement (47.4%; $X^2 = 34.67, p = 0.00$). Picture in posters/ billboards attracts farmers to them (94.2%; $X^2 = 76.5, p=0.00$). Secondary educated farmers (64.6%; $X^2 = 13.49, p = 0.04$) were attracted to posters/billboards by their pictures. However, more female (51%) look on billboards than males ($X^2 = 6.81, p=0.01$).

Among the 71.1% of farmers who heard about HPAI on radio, 66.9% heard from National radio. Generally, 63.4% of farmers heard HPAI from news with 27.6% from agricultural programs. However, most farmers who heard HPAI on State radio heard in the news (80.5%) while those who heard on the National radio heard from an agricultural program (32.9%; $X^2 = 12.31, p = 0.02$). Farmers who listened to State radio (56.4%) heard about HPAI on State radio while 84.8% of National radio listeners heard about HPAI on National radio ($X^2 = 24.54, p=0.00$). Over 71 % of farmers who heard HPAI on National radio had secondary education though only 2.4% of Islamic educated farmers heard about HPAI on National radio with 7.3% having heard on state radio ($X^2 = 6.36, p = 0.04$). Farmers who heard HPAI on radio listened to the program with family (90.6%), friends (61%) or family and friends (80%) though 64.7% listened alone ($X^2 = 14.47, p=0.01$). Seventy per cent of those who listen to HPAI program alone and with family (58.3%) heard about HPAI in the news while those who listen with friends (48%) heard in agricultural program ($X^2 = 28.03, p=0.03$).

Fifty – two per cent of farmers who read publications had not read about HPAI in any publication though amongst those who have read about HPAI, 28% read in

Daily Trust newspaper (Fig. 1). The language of publication on HPAI were English for Daily Trust (29.6%), Hausa for GTK (56.3%) and English and Hausa for New Nigerian (85.7%; $X^2 = 50.10, p = 0.00$).

Ninety-eight per cent of farmers had neither seen nor read the AICP bulletin on HPAI.

About a third of respondents who watch TV had watched a TV program on which HPAI was mentioned though 65.2% farmers watched the program on National TV with less than a third who watched on state TV ($p = 0.00$). However, 94.4% of respondents who watch National TV watch HPAI program on National TV with over three-quarter of State TV viewers having watched the program on State TV ($X^2 = 118.14, p = 0.00$). When showed an AICP TV advert on HPAI, 93.6% of farmers reported they have never watched or listened to the advert.

When farmers were presented with five AICP sponsored posters, 75.7% of farmers had not seen any of the posters with only 2.3% who have seen all 5 posters. Likewise, 91.9 % of farmers had never seen any of the two AICP stickers presented though only 1.2% of the farmers had seen both stickers.

Over 78.6% of farmers who recommended road junction as placement site for posters had not seen any of the AICP posters ($X^2 = 210.53, p= 0.00$). Over a third of those who suggested the mosque as an ideal place for posters placement were between 25 – 34 years old ($X^2 = 35.82, p = 0.01$).

When asked what farmers remembered from HPAI program listened to from radio, responses include it causes high mortality (19.1%), or it being a serious disease (13.9%) amongst others (Fig. 2). National radio listeners, who heard about HPAI on National radio, remembered that HPAI causes high mortality (26.8%) in poultry and the need to report sick or dead poultry (1.2%). State radio listeners remembered to protect self from HPAI

(19.5%) and that HPAI is a serious disease (Fig. 3).

Morning listeners (17.4%) remembered the need to protect self compared to evening listeners (6.7%) though only 2.2% of evening listeners remembered cooking poultry properly against 6.5% of morning listeners ($X^2 = 86.52, p = 0.00$). A quarter of those who listened to HPAI program with family and friends could remember only the need to wash hands with soap and water ($X^2 = 95.18, p = 0.00$). However, those who heard about HPAI in the news could only remember that it is a serious disease (30.8%) while those who heard in an agricultural program (26.5%) remembered that it causes high mortality in poultry ($X^2 = 102.52, p=0.00$).

Over three quarter of farmers who have never read the AICP bulletin reported that the message would not affect their behaviour (76.6%) though all those who have read the bulletin prior to the study revealed that the message would change their behaviour ($X^2 = 45.79, p=0.00$). High mortality in poultry was what 47.8 % of farmers remembered of the HPAI program watched on TV. State TV viewers remembered the need to protect self from HPAI (13.6%; $X^2 = 91.97, p= 0.00$).

Upon watching the AICP TV advert, 56.6% of the farmers reported understanding the advert and that it would positively affect their behaviour towards handling poultry. Of the farmers that had not seen any of the 5 AICP posters presented, 67.1% understood the messages of all the posters when showed. Farmers who did not understand the posters, indicated posters P1 (27.1%) and P3 (11.9%) as the posters they did not understand with 61% of farmers not understanding any of the posters. The posters would affect 61.8% farmers' attitude towards poultry. However, two-third of farmers revealed that they did not understand the messages on the stickers and the messages would not affect their poultry handling practices.

Over seventy-one per cent of

farmers who look at billboards and posters understood the message of all the AICP posters ($X^2 = 10.2\%; p = 0.00$) though 35.3 % reported the message would not affect their attitude toward poultry handling ($X^2 = 4.79, p = 0.03$). Fifty-five per cent of farmers who look at billboards and posters do not understand the message on the stickers ($X^2 = 4.79, p = 0.03$). Sixty – eight per cent of respondents who suggested road junction as the best place for posters/billboards understood the posters' messages though all farmers who recommended the mosque for posters placement did not understand the poster message ($X^2 = 12.13, p = 0.02$). Eighty-six per cent of farmers who view posters or billboards because of the site of placement understood the messages of stickers although 56.3% of farmers attracted by the pictures of posters did not understand stickers messages ($X^2= 7.94, p=0.04$) with 62.5% reporting the stickers messages would affect their poultry handling practices.

Discussion

The study revealed that despite the constraint of non-availability of or erratic power supply and expenses involved in maintaining radio and television, they are preferred sources of information to LP farmers (Apantaku *et al.*, 1998; Gueyè, 2009; Igwe *et al.*, 2008; Durosinlorin, 2008) and are practicable sources of agricultural information. The finding is contrary to previous reports of low TV viewership and inability of LP farmers to watch TV because they cannot afford TV (Okwu *et al.*, 2006; Gueyè, 2009).

News were the favourite programs of radio listeners and TV viewers, implying that information for LP farmers can be disseminated through news (Adekunle *et al.*, 2004). However, State and National stations were favourite stations contrary to a study by Adekunle *et al.*, (2004), where Ago-Are and Tede communities' arable farmers' favourite TV and radio stations were State

and private stations. This difference might be as a result of proficiency of these arable farmers in English Language as state and private stations broadcast programs in the local language.

Though the widest radio listenership was obtained in the mornings and evenings, the afternoon radio listeners were usually women and listened with family members mainly children when preparing the evening meal while their husbands are at work. These women are equally important in HPAI control as they are usually the careers of local poultry (Abdu *et al.*, 1999; Ahlers *et al.*, 2009).

Readership of publications among LP farmers was poor probably because they do not address issues of interest to LP farmers or farmers cannot afford to buy publications due to high cost. Contrary to previous reports that attributed low publication readership to illiteracy of farmers (Okwu *et al.*, 2006), this study revealed most LP farmers had secondary education. The poor readership of publications reported in this study is contrary to a study carried among commercial poultry farmers in Ibadan, Nigeria (Aderinto and Adisa, 2006) which reported higher readership of newspapers due to high literacy level of the farmers. Though magazines are more expensive, they are usually read by the educated LP farmers. However, bulletins are usually published in Hausa and given out free as they carry information to farmers.

Billboards and posters placed in schools, churches and road junctions were suggested as appropriate media channels for LP farmers contrary to the report by Okwu *et al.*, (2006). The colourful pictures of posters and billboards attract LP farmers who are usually poorly educated as they proffer visualisation making the posters and billboards self explanatory (Mgbada, 2006; Ahlers *et al.*, 2009) though contrary to reports by Ejembi *et al.* (2006) that indicated difficulties in interpreting pictures by farmers in Makurdi LGA in Benue State, Nigeria. This study revealed that farmers would not

understand a single poster addressing many themes or when poster picture does not clearly show what is expected from the audience.

Secondary school graduates listen to National radio because they understands the English language hence read publications unlike Islamic educated LP farmers who would prefer State radio which broadcast in English and 'Hausa' and have more Islamic oriented programs. The study revealed that TV could be an alternative channel of information distribution to some non-radio listeners.

Similar to previous report, radio was a key medium of informing LP farmers about HPAI (Durosinslorin, 2008) unlike TV which was poorly utilized for HPAI coverage contrary to reports by Aderinto and Adisa (2006). Poor TV coverage resulted in the poor recognition of HPAI among LP farmers as the audio-visual advantage involving more human senses of sight, hearing and feeling in analysing message ensuring higher chances of behavioural change was not utilized by LP farmers (Adedoyin and Adebayo, 2005).

State radio and TV stations performance on HPAI information dissemination was poor which might have a negative impact on HPAI education of LP farmers who resides in rural communities where State radio and TV reception are better compared to National stations. State radio and TV programs are usually broadcast in the local language which farmers understand better and these programs are design considering farmers' socio-cultural and economic background. The poor coverage by State media might be as a result of inadequate state media personnel knowledgeable on HPAI; inability of media management to involve state veterinarians in HPAI programs or poor perception of media management on HPAI risk perception and how it affects the rural communities.

The study revealed that the appropriate time to broadcast HPAI information targeting LP farmers should

be in the mornings and evenings through the radio (Anigwe, 1990; Adekunle *et al.*, 2004) and in the evenings through the TV (Nwachukwu and Akinbode, 1989; Adekunle *et al.*, 2004). Though morning radio listeners listen alone, they could discuss the information with friends and colleagues while performing their daily chores. However, evening radio listeners (Adekunle *et al.*, 2004) and TV viewers listen or watch HPAI programs with family and/or friends enabling issues raised in the program to be discussed among farmers which might improve the understanding of the issues for those who did not understand.

The LP farmers need for agricultural information was reflected in their viewership or listenership of agricultural programs. These farmers are important as entry points for introduction of HPAI knowledge in their communities as they are considered more receptive to innovations (Adekoya and Tologbonse, 2005).

However, TV would complement radio and articulate the risk perception of LP farmers on HPAI better while improving the chances of behavioural change of farmers' risky poultry handling practices contrary to reports by Okwu *et al.*, (2006) that TV would be counter-productive as a means of disseminating agricultural information to rural communities.

Radio listeners and TV viewers could recall mainly high mortality in poultry and that HPAI is a serious disease from HPAI program watched. This was as result of information source been the news and explains the lack of behavioural changes as LP farmers continue to practice HPAI risky behaviours such as eating and selling of sick or dead poultry, living closely with poultry, use of poultry faeces for manure and inability to report poultry death (Durosinlorin, 2008; Fasina *et al.*, 2009). There is the need to re-evaluate HPAI message being broadcasted (Okwu *et al.*, 2006) in the radio and TV to include disease recognition, the need to report sick and dead poultry, where to report disease outbreak and avoidance of

HPAI risky behaviours.

Though state radio reported the need to protect self, the only protective measures LP farmers could remember were wash hands with soap and water and cook poultry properly which might be because these practices are similar to their cultural practice hence the ease of identifying with the practices. Discussion with some LP farmers revealed that the commercial poultry are source of HPAI rather than the indigenous poultry hence the need to protect self from commercial and not indigenous poultry further highlight the gap in HPAI message packaging by the media.

The study revealed that placing HPAI information in the news section of a newspaper or agricultural section of magazines and bulletin would ensure wide readership among LP farmers. The inability of more than half of the publication readers not to read about HPAI in their publication might be that HPAI has not been mentioned in the readers' favourite section of the publication

The relationship of what farmers remembered from HPAI program with the station and program that information on HPAI was heard; time of listening to the program and person they listen with is similar to previous study (Okwu *et al.*, 2006). This is because the time of listening to the program determines who they listen with and possibility of ensuring discussion clarifying the issue to those who did not understand the message. The discussion generated by the HPAI program would also ensure long term memory retention of issues discussed (Adekoya and Tologbonse, 2005) which might create a favourable condition for listeners and viewers to attempt a trial if the person who understands the issues discussed in the program is respected and trusted within the community (Adekoya and Tologbonse, 2005).

The low distribution of the AICPTV advert among LP farmers might be due to the low coverage of HPAI by state TV possibly because of little or non involvement of state

TV in AICP sponsored HPAI programs. The ability of the advert to bring about behavioural change is because more human senses are involved in evaluation of the message as seeing the pictures and hearing message ensure better understanding and a sense of participation (Lawal-Adebowale and Adebayo, 2006; Adebayo *et al.*, 2008). There is the need for AICP to involve the State TV and radio in dissemination of HPAI information through sponsorship of HPAI programs on State radio and TV.

The poor circulation of AICP bulletins, posters and stickers among LP farmers is because the agricultural extension services is apparently non-existing or the LGAs AICP information desk officers are not engaging the extension services in HPAI control. It might also be that these educational materials are not sent to the rural communities but left in AICP offices at federal or state AICP secretariats. In some instances, stickers and posters were given only to individuals favoured by the LGAs information desk officers as some LGAs AICP animal health desk officers had not seen most of the materials. The poor circulation of HPAI educational materials could be ameliorated with the establishment of a functional community dialogue system (CDS) as recommended in the Nigeria's Highly Pathogenic Avian Influenza Preparedness Plan (AICP, 2007).

The inability of the bulletins to bring about attitudinal change might be because LP farmers can not perceive the risk of HPAI from the bulletin as a result of the need to reflect on message in bulletin which takes a longer time as confirmed by the study. The study indicates that publications are not good channel for HPAI information dissemination to LP farmers.

Placement of billboards/posters in mosques would improve Islamic educated LP farmers access to HPAI information as their radio listenership and publication readership were poor coupled with their important role in the LP production chain

(Assam, Unpublished). Moslem youths could serve as initiators of HPAI advocacy campaign among the Moslem communities who are less informed on HPAI control.

These posters and billboards can adequately convey the risk involved in HPAI risky practices resulting in avoidance of these practices. The AICP posters if understood could induce desired behavioural change among LP farmers for the aforementioned reasons.

The absence of pictures makes it difficult for farmers to understand stickers' messages and effect appropriate changes on their poultry handling practice that would assist in HPAI control.

The results of this study may be broadly generalized to the southern part of the country despite the socio-cultural differences. However, it is also applicable to other states in Northern Nigeria and neighbouring countries like Niger Republic, Cameroon and Chad sharing cultural similarities.

In conclusion, radio, television, billboards and posters are viable channels of information dissemination to LP farmers. However, LP farmers' access to HPAI educational materials was very poor though television and posters' messages were better understood than bulletins and stickers' messages.

Conclusions

Radio and television are viable channel for HPAI information dissemination to LP farmers unlike publications readership which was low. However, television is better at articulating HPAI risk perception of LP farmers though State owned radio and TV coverage of recent HPAI outbreak was inadequate. Farmers listen to radio in the morning alone although evening radio listeners or TV viewers listen or watch with family, friends or family and friends. News and agricultural programs were favourite programs for LP farmers who

read publications or watched television or listened to radio. Billboards and posters had high viewership and were easily understood by LP farmers though pictures in posters and billboards were important at attracting the attention of LP farmers.

High mortality in poultry was what farmers remembered of the HPAI program listened on radio or watched on television. Distribution of AICP educational materials among LP farmers was low. Audio-visual and posters message were better understood by LP farmers unlike bulletin and stickers which were not clear.

Recommendations

Highly pathogenic avian influenza information targeting LP farmers should be channelled through radio, television or posters and billboards. State radio and television should increase HPAI programs in their schedules and ensure human resource development in HPAI information broadcasting. Nevertheless, radio and television HPAI message should be revised to include disease recognition, need for LP farmers to report and where to report sick or dead poultry and the need to avoid HPAI risky behaviours. Muslim youths should be engaged to HPAI advocacy within Muslim communities.

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STUDIES ON PARASITIC GASTROENTERITIS IN SHEEP

Farid Fouad Moustafa Salem*, Mohamed Moustafa Abd- El- Sameaa and Mohamed Nagi Sleem EL-Sheary

*Veterinary Teaching hospital. Fac. Vet. Med., Mansoura University, Egypt
Department of animal medicine, Faculty of Vet. Medicine, Ismailia, Suez Canal University.

Summary

This study carried out at Dakahilia province in Nile Delta, Northern Egypt. To investigate some aspects of *gastrointestinal nematode* infestation as; prevalence, intensity of infestation according fecal egg counts, the effect of infestation on some hematological and biochemical parameters, and the efficacy of Albendazole, Ivermectin and Moxidectin in the treatment of infested cases. 532 native sheep of different ages (3 months to more than 2 years) were used from different localities during the period from October 2002 to September 2003. 408 out of 532 sheep were found to be infested with *gastrointestinal nematodes* with overall prevalence (76.69%) But, the majority of infested animals were of mild intensity of infestation according to the mean values of fecal egg counts. As counts of 100-500 EPG represented (75.24%) and counts of 500-2000 EPG represented (22.06%) whereas counts of 2000-5000 EPG represented only (2.69%). Results cleared a seasonal pattern and an age profile with significant differences. The overall prevalence of *Trichostrongylus ovis*, *Strongyloides papillosus*, *Nematodirus* spp were (4.32%), (9.96%) ,and (3.00%) respectively whilst other *Trichostrongyloides* represented 75.75%. Fecal culture and larvae identification cleared the prevalence of the important abomasal *Trichostrongyloides* in decreasing order as *Trichostrongylus* spp (48.50%), *Haemonchus contortus* (37.35%), and *Ostertagia* spp. (28.84%). Naturally infested sheep revealed significant decrease of RBCs count, hemoglobin content and PCV especially in *hemochrosis* cases. Also, a significant increase in total leucocytic count is noticed. The results revealed also significant *neutophilia*, *eosinophilia*, and *monocytosis* while lymphocyte percent decreased significantly with infestation (lymphopenia). Treatment trial results revealed that, the comparative effectiveness of the three drugs was best for the Moxidectine treated group followed by the Ivermectine treated group then Albendazole treated group.

Key words: gastrointestinal nematodes, efficacy, Albendazole, Ivermectin, Moxidectin

ETUDES SUR LA GASTRO-ENTÉRITE PARASITAIRE CHEZ LES OVINS

Résumé

La présente étude a été réalisée dans la Province de Dakahilia, dans la Région du Delta du Nil, au Nord de l'Égypte et portait essentiellement sur certains aspects de l'infection par les nématodes gastro-intestinaux, à savoir : la prévalence, l'intensité de l'infection en fonction du nombre des œufs que contiennent les matières fécales, l'incidence de l'infection sur certains paramètres hématologiques et biochimiques et l'efficacité de l'albendazole, de l'ivermectine et de la moxidectine dans le traitement des ovins infectés. Pour les besoins de l'expérience, 532 ovins de différents âges (entre 3 mois et plus de 2 ans) vivant à l'état naturel ont été mis en observation dans diverses localités durant la période comprise entre octobre 2002 et septembre 2003. L'on a été constaté que sur les 522 ovins sélectionnés, 408 étaient infectés par des nématodes gastro-intestinaux et présentaient une prévalence globale desdits parasites à hauteur de 76,69%. Mais selon la teneur moyenne en œufs des matières fécales, l'intensité de l'infestation affichée par la majorité des animaux contaminés était faible. Les chiffres de 100 à 500 œufs par gramme représentaient 75,24% de taux d'infection, 500 à 2000 œufs par gramme représentaient 22,06% de taux d'infection alors que 2000 à 5000 œufs

par gramme ne représentaient que 2,69% de taux d'infection. Les résultats de l'expérience ont mis en évidence un caractère saisonnier de ces infections et un profil d'âge présentant des différences notoires. La prévalence globale de chacun des parasites suivants *Trichuris ovis*, *Strongyloides papillosus*, *Nematodirus* spp était (4,32 %), (9,96 %) et (3,00 %) respectivement, à l'inverse des autres *Trichostrongyloidea* qui représentaient 75,75% du taux d'infection. La coproculture et l'identification des larves ont permis de déceler la prévalence en quantités importantes des *Trichostrongyloidea* de caillette selon l'ordre décroissant suivant : *Trichostrongylus* spp (48,50%), *Haemonchus contortus* (37,35%), and *Ostertagia* spp. (28,84%). Les ovins infectés par les parasites présentent naturellement une baisse très importante de leurs globules rouges, de la teneur en hémoglobine et de l'hématocrite, notamment dans les cas d'hémochose. L'on a également noté une augmentation impressionnante du nombre des leucocytes. Les résultats ont également révélé la présence en quantité abondante de leucocytes neutrophiles, des granulocytes éosinophiles et des monocytes, à l'inverse des lymphocytes dont le pourcentage a considérablement diminué en raison de l'infection (lymphopénie). Il ressort clairement des résultats du traitement d'essai appliqué par groupe d'animaux infectés que le classement en termes d'efficacité curative des médicaments utilisés est le suivant: La moxidectine s'est avérée le meilleur produit, suivie l'ivermectine et, enfin, de l'albendazole.

Mots clés : nematodes gastrointestinales, efficacité, albendazole, ivermectine, Moxidectine

Introduction

Sheep meat is widely consumed through the world, especially the Arab nations (Martin and Aitken, 2000). Nutritional insufficiency and gastrointestinal nematode parasitism are major constraints to small ruminant production (Knox and Steed, 1996). Gastrointestinal helminthes are major contributors to reduced productivity and can lower the production of meat, milk and wool (Coop and Holmes, 1996). The gastrointestinal nematode parasitism resulted in negative influence on both the average daily gain of body weight and the rate of growth of wool (Niezen *et al.*, 1995). Parasitic gastroenteritis is a common and important problem in sheep and responsible for heavy economic losses especially in tropical and subtropical areas (Mendoza *et al.*, 1998).

Diagnosis of parasitic gastroenteritis begins through the epidemiological features and clinical pictures of disease, however it must be confirmed by coprological examination for detection of the eggs. The eggs of some gastrointestinal nematodes are unique in their shape like that of *Nematodirus* spp. and *Trichuris* spp. The egg of other nematodes may confuse with each other, therefore

fecal culture is necessary for identification of the third stage larvae (Kelly, 1990). Boag and Thomas (1977) proved the reliability of egg counts as a reflection of worm burden, which concluded from monthly postmortem, worm counts in association with fecal egg counts and pasture larval counts.

Efficient and humane sheep farming requires the control of nematode infections in grazing sheep (Stear *et al.*, 1997). Anthelmintic treatment with or without grazing management is the method of choice for most farmers. However, the sustainability of anthelmintic treatment is threatened by the evolution of drug resistance in parasite populations (Jakson, 1993). Keraboeuf *et al.*, (1995) recorded that the efficacy of moxidectin against benzimidazole resistant isolates (*Haemonchus contortus*, *Teladorsagia circumcincta*, *Trichostrongylus colubriformis* and *Cooperia curticei*) was 100%. They added that no adverse reaction to the drug was observed.

In Egypt, the parasitic gastroenteritis problem is graver in Nile Delta in which farming system is characterized by bad management and bad welfare due to space insufficiency in farmers' pens. Therefore alternative control system based on

Table 1: Examined sheep according to age, sex, and season.

Localities	Age			Sex		Season				Total
	A	B	C	Male	Female	Autumn	Winter	Spring	Summer	
Mansoura	44	39	47	48	82	36	25	34	35	130
Talkha	43	38	44	46	79	34	32	35	24	125
Nabarrow	36	32	39	39	68	25	32	26	24	107
Aga	28	21	31	29	51	20	15	20	25	80
Senbellawen	31	30	29	33	57	20	21	22	27	90
Total	182	160	190	165	337	135	125	137	135	532

A: Sheep age 3 months up to 1 year.

B: Sheep age 1-2 year.

C: Sheep age over 2 years

pasture management is not possible and the anthelmintic treatment alone is the current method for most farmers attempting to minimize nematode infection with its high cost and the risk of drug resistance evolution. This problem is discussed by many Egyptian workers with variable rates of incidence (9.37%- 71.74%). In present work we are interested in determination the gastrointestinal nematode infestation incidence in sheep at Dakahlia governorate. Studying the effect of welfare, age, sex and season on sheep infestation as well as the effect of gastrointestinal nematode infestation on some hematological and biochemical parameters. The efficacy of Albendazole, Ivermectin and Moxidectin in the treatment of infested cases was monitored as well.

Materials and Methods

Animals and study area:

532 native sheep of different ages (3 months to more than 2 years) were used from different localities during the period from October 2002 to September 2003 for studying the prevalence of gastrointestinal nematode infestation and the Effect of age and year seasons on infestation rate.

Twenty lambs aging (5-9 months old) naturally infested with gastrointestinal nematodes and five non-infested controls were used to evaluate the anthelmintic efficacy of Albendazole, Ivermectin and Moxidectin.

Samples:

Fecal samples are examined as soon as possible in the same day and if not, were refrigerated (at 4°C) till the next day and therapeutic trials samples were collected 2 days before and after treatment by 1, 2, 3, 4, 5, 6 and 7 days. From infested sheep (20) as well as from control non infested sheep (5),

Blood samples. Two blood samples were collected 2 days before treatment and at 2 and 4 weeks post treatment. The first was taken on potassium EDTA for hematological picture whereas the second without anticoagulant to separate serum subjected to biochemical parameters.

Clinical and parasitological examinations:

All investigated sheep were exposed to fully clinical examination according to Kelly (1990). Fecal samples were examined macroscopically as well as microscopically through direct smear and concentration floatation techniques. As a measure of the severity of an animal's worm burden, the fecal egg count was carried out using modified McMaster technique according to Soulsby (1982).

The mean number of detected eggs was calculated as follows:

Number of eggs/gm = (total number of eggs counted ÷ number of counting chambers) × 200

Fecal culture and larval differentiation were carried out as well for identification of

the third stage larvae according to Georgi (1987).

Hematological examinations:

Blood films were prepared and Giemsa stained for differential leucocytic counts, as total WBCs and RBCs were counted per cubic millimeter according to Cart-Wright (1968). Blood hematocrit value (PCV) was determined by microhematocrit method using microhemtocrit centrifuge according to Wintrobe *et al.*, (1976). Hemoglobin content was estimated using hemoglobinmeter (SAHLI) according to Wintrobe *et al.*, (1976) as well.

Biochemical examinations:

Total serum protein was determined by spectrophotometrically described by Weichselboum (1946) and serum albumin was determined by colorimetric method according to Doumas *et al.*, (1971). Serum globulin was calculated by subtracting the value of serum albumin from the value of serum total protein.

All of the used kits were produced

by Stanbio laboratory inc. gamatrade co. (Stonbio Laboratory, Inc. east Houston street Son Antonia, Texas)".

Results and discussion

Overall incidence and intensity of infestation.

408 out of 532 sheep were found to be infested with gastrointestinal nematodes with overall prevalence (76.69%) But, the majority of infested animals were of mild intensity of infestation according to the mean values of fecal egg counts. As counts of 100-500 EPG represented (75.24%) and counts of 500-2000 EPG represented (22.06%) whereas counts of 2000-5000 EPG represented only (2.69%).

The mild intensity of infestation according to the mean of fecal egg counts is consistent with the observed clinical signs which in the majority of cases ranged from subclinical infection with sheep appearing relatively healthy to mild clinical signs. There were no deaths within infested sheep during the period of this work. (1981), Shawkat *et al.*, (1991), El-Azazy (1995), El-

Table 2: The overall incidence and intensity of infestation according to fecal egg count

Total investigated sheep	Infested sheep		Fecal egg counts							
	No	Overall Incidence	100-500		500-2000		2000-5000		More than 5000	
			No	%	No	%	No	%	No	%
532	408	*	307	**	90	**	11	**	-	**
		76.69	75.24	22.06	2.69	-	-	-	-	-

* % = Percent in relation to total examined sheep.

** % = Percent in relation to total infested sheep

Table 3: Relationship between fecal egg counts and age of infested sheep.

Age category	Ex. No	Inf. No	Inf. %	Mean No of fecal egg counts/gm feces							
				100-500		500-2000		2000-5000		Over 5000	
				No	%	No	%	No	%	No	%
A	182	154	84.61	114	74.03	35	22.70	5	3.26	-	-
B	160	113	70.56	87	76.99	24	21.23	2	1.76	-	-
C	190	141	74.21	106	75.17	31	21.98	4	2.84	-	-
Total	532	408	76.69	307	75.24	90	22.06	11	2.69	-	-

A: 3 months up to 1 year
Ex. No: Examined number

B: 1-2 year
Inf. No: Infested number

C: Over 2 years

Table 4: Percentage of gastrointestinal nematodes of sheep in relation to localities and sex.

Locality	Examined No	Infested No	%	Male			Female		
				Ex. No	Inf. No	%	Ex. No	Inf. No	%
				Mansoura	130	100	76.92	48	34
Talkha	125	97	77.60	46	34	73.91	79	63	79.75
Nanarrow	107	83	77.57	39	28	71.79	68	55	80.88
Aga	80	61	76.25	29	20	68.96	51	41	80.39
El-Senbellawen	90	67	74.44	33	23	69.70	57	44	77.19
Total	532	408	76.69	195	139	71.28	337	269	79.82

Managemental characteristics may responsible for variations in infestation rate regarding locality. Results cleared that the highest infestation rate is recorded at Talkha (77.60%) followed by Nabarrow (77.57%), Mansoura (76.92%), Aga (76.25%), and El-Senbellawen (74.44%).

Table 5: Seasonal variation of gastrointestinal nematode infestation among sheep.

Sea-son	Ex. No	Inf. No	Inf.%	Trichuris				Strongyloides				Nematodirus				Other Trichostrongyloids			
				P	*	T	%	P	*	T	%	P	*	T	%	P	*	T	%
				M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Autumn	135	113	83.70	1	9	10	7.40	1	17	18	13.33	-	6	6	4.44	85	26	111	82.22
Winter	125	100	80.00	1	6	7	5.18	1	14	15	12.00	-	5	5	4.00	78	20	98	78.40
Spring	137	102	74.45	-	5	5	3.64	1	14	15	10.94	-	4	4	2.92	80	21	101	73.72
Summer	135	93	68.89	-	1	1	0.74	-	5	5	3.70	-	1	1	0.74	74	19	93	68.88
Total	532	408	76.69	2	21	23	4.32	3	50	53	9.96	-	16	16	3	317	86	703	75.75

P = Pure infestation

M = Mixed infestation

T= Total

* Mixed infestation with other Trichostrongyloids.

** Mixed infestation with other gastrointestinal nematodes.

NB: the total number of infested animal equal to summation of pure infestation of all plus Mixed infestation with other nematode (**).

% : in relation to the number of examined animal in each season.

Sawalhy and Hassan (1996), Hashem (1997), Abdel-Wahed and Badran (2003) whom recorded (53.30%), (65.83%), (47.90%), (42.86%), (65.80%), (42.66%), and (45.87%) respectively. In Table (2) The intensity of infestation according to the mean values of fecal egg counts in our study is milder than that recorded by Shawkat et al., (1991) Vcounts of 100-500 EPG (32.60%) and counts of 500-2000 EPG (27.80%) whereas counts of 2000-5000 EPG represented (16.44%). The high prevalence rate and low intensity of infestation in our study may be attributed to continuous infection due to bad management and welfare especially space insufficiency and continuous indiscriminate

treatments which only minimizes the intensity of infestation without efficient integrated control measures.

The infestation rate and age

Infestation rate and fecal egg counts results cleared that lambs aged 3 months up to 1 year were more susceptible showing the highest infestation rate (84.61%) that ascertained by highest rate of fecal egg counts 2000-5000 EPG (3.26%). whereas sheep aging 1-2 years showed lowest susceptibility.

These results were supported by Anjasi and Williams (1987), El-Faummy (1989) and Stear et al., (2000) whom obtained

similar results. Anjasi and Williams (1987) reported that the young animals harboured a significantly higher worm load than old animals which may attribute to higher susceptibility. Age susceptibility may be attributed to acquired immunity, which lacked in young animals, as they were not exposed to previous infestation. Animals over 2 years were moderately susceptible possibly due to immunity relaxation during pregnancy and lactation in ewes and as a consequence, the female sheep are more infested with gastrointestinal nematodes (79.82%) than males (71.28%).

Seasonal variation

Results cleared that the highest infestation rate is recorded during autumn and winter (83.70%) and (80.00%) respectively whereas the lowest infestation rate is recorded during spring and summer seasons (74.45%) and (68.89%) respectively. Records of Soulsby (1982) who reported that most destructive factor are high temperatures and dryness could explain the variation of infestation during different seasons. In Egypt, autumn and winter seasons are the most favorable for parasite development and survival; as the autumn is the most pleasant season all over the year and winter is not so cold. In spring temperature increased causing a moderate drop in infestation rate, while the summer season in Nile delta not drastically affect the survival of the different stages of parasite because it is neither so hot nor so dry. However, it is probably fair to say that the gastro intestinal nematode parasitism is a constraint to sheep production in Egypt all over the year but with seasonal pattern with higher level of infection during, autumn and winter seasons. The same results were obtained by El-Akabaway (1987).

The over all prevalence of *Trichuris ovis*, *Strongyloides papillosus*, *Nematodirus spp* were (4.32 %), (9.96 %) ,and (3.00 %) respectively whilst Other *Trichostrongyloides* represented 75.75%. With respect to *Trichuris ovis* prevalence;

Table 6: Seasonal dynamics of the important abomasal trichostrongylids in fecal culture in sheep.

Sea- son	Ex- No	Inf. No	Inf.%	Haemonchus con- tortus			Ostertagia spp.			Nematodirus			Trichostrongylus spp.						
				P	*	M	P	*	M	P	*	M	P	*	M				
Au- tumn	135	113	83.70	10	40	50	37.03	15	28	43	31.85	24	47	71	52.59	85	26	111	82.22
Win- ter	125	100	80.00	5	33	38	30.40	20	21	41	32.80	21	45	66	52.80	78	20	98	78.40
Spring	137	102	74.45	25	30	55	40.14	4	35	39	28.47	12	54	66	48.18	80	21	101	73.72
Sum- mer	135	93	68.89	37	18	55	40.74	7	23	30	22.22	6	49	55	40.74	74	19	93	68.88
Total	532	408	76.69	77	121	198	37.35	46	107	153	28.84	63	195	258	48.50	317	86	703	75.75

it in agreement with Lopes et al., (1975), El-Faamy (1989), Shawkat et al., (1991), and Hashem (1997) who obtained nearly similar percentage of (3%), (4.5%), (4.5%), and (4.8%) respectively but lower than that obtained by Ansari and Singh (1981) who recorded (40.4%). Concerning *Strongyloides papillosus* prevalence; it agreed with those obtained by Shawkat et al., (1991), Hashem (1997), and Badran (2003) who recorded nearly similar percentage of (10%), (8%), and (14.65%) respectively whereas lower

than that obtained by Lopes *et al.*, (1975) who reported (40.00%). *Nematodirus spp* prevalence nearly agreement with that of Pfister (1979), El-Faumy (1989), and Hashem (1997) who obtained nearly similar percentage of (8%), (2.83%), and (0.8%). On the other hand it lower than that obtained by Cornejo and Fernando (1987) and Alani and Yahya (1993) who reported a percentage of (35%), and (32.4%) respectively.

Fecal culture and larvae identification cleared the prevalence of

the important abomasal *Trichostrongyloids* in decreasing order as *Trichostrongylus spp* (48.50%), *Haemonchus contortus* (37.35%), and *Ostertagia spp.* (28.84%).

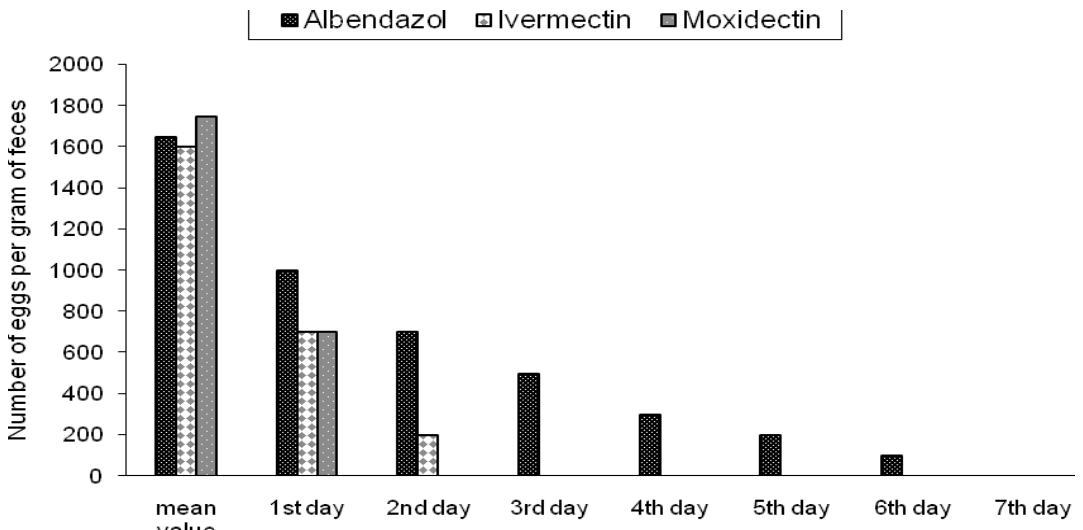
With respect to *Trichostrongylus spp.* prevalence rate; it agreed with those obtained by Mckenna *et al.*, (1974), Ansari and Singh (1981), and Alani and Yahya (1993) who reported nearly similar rates of (49.00%), (36.60%), and (33.29%) respectively. On the other hand Shawkat *et al.*, (1991) and Hashem (1997) were obtained a lower rate

Table 7: Mean values of eggs per gram of sheep feces post treatment by albendazole, ivermectine and moxidectin.

Animals	Mean EPG* Before Treatment	EPG after treatment													
		1st day	2nd day	3rd day	4th day	5th day	6th day	7th day	8th day	9th day	10th day	11th day	12th day	13th day	14th day
Albendazol Treated group	1650	1000	700	500	300	200	100	0	0	0	0	0	0	0	0
Ivermectin Treated group	1600	700	200	0	0	0	0	0	0	0	0	0	0	0	0
Moxidectin Treated group	1750	700	0	0	0	0	0	0	0	0	0	0	0	0	0

* EPG: Number of eggs per gram of feces

Figure 1: Mean values of eggs per gram of sheep feces post treatment by albendazole, ivermectine and moxidectin.



of (28.90%), and (22.41%) respectively. The *Haemonchus contortus*. prevalence rate is in agreement with prevalence with those results obtained by Ansari and Singh (1981), Hashem (1997), Lindqvist *et al.*, (2001), and Badran (2003) who recorded nearly similar percentage of (32.20%), (30.17%), (37.00%), and (25.47%) respectively, differ from those recorded by Lopes *et al.*,(1975) and Fakae (1990) who reported (60.00%), and (87.00%) respectively. Concerning *Ostertagia spp.* prevalence rate; it agreed with those obtained by El-Faomy (1992) and Shawkat *et al.*, (1991) who reported a percentage of (17.10%), and (17.8%) respectively. On contrary to our result, Le. Riche *et al.*, (1973) and Mckenna *et al.*, (1974) were obtained higher rates of (77.53%), and (67.00%) respectively whereas Badran (2003) in Egypt recorded a lower rate (8.59%).

Results cleared that all nematode species go after the same manner in seasonal variation except *Haemonchus contortus*. Which its highest rate of infestation was in summer season (40.74%) followed by spring (40.14%), autumn (37.03%) and its lowest rate in winter (30.40%). This exception is supported by El-Faomy (1992) and this may be attributed to poor nutrition in summer season.

The low intensity of clinical signs observed in the majority of infested animals in this study is coinciding with the low fecal egg counts observed in the majority of infested sheep as fecal egg counts 100-500

represented 75.24% from infested sheep. Concerning to Albendazole treated group; the mean faecal egg count reduced from 1650 before treatment to 100 EPG at the 6th day post treatment and completely disappeared at the 7th day post treatment. This result agreed with that obtained by Maiti *et al.*, (1999), Waruiru (1997) and Badran (2003) but Scala *et al.*, (1999) reported that albendazole not effective against *Trichuris ovis* and Keuuyu (2002) reported that only (59.40%) reduction in faecal egg count was achieved ten days post treatment with albendazole. In case of Ivermectin treated group; the mean faecal egg count reduced from 1600 before treatment to 700 then to 200 EPG after 24 and 48 hours respectively post treatment and completely disappeared at the 3rd day post treatment. Similar results were previously reported by Dorchies *et al.*, (2001), Shawkat *et al.*, (1991), Craige *et al.*, (1992), Pankavich (1992), El-Sawalhy and Hassan (1996), Han *et al.*, (1997), El-Sawalhy and Hassan (1996), Waruiru (1997), and Badran (2003). On the other hand Miller and Barras (1994) found that there was essentially no difference in mean faecal egg count of *Haemonchus contortus* before and after treatment. With respect to Moxidectin treated group; the mean faecal egg count reduced from 1750 before treatment to 700 EPG within 12 hour post treatment and completely disappeared 48 hour post treatment recording 100% efficacy as early

Table 8: Hematological parameters of non infested and infested sheep before and at 2 and 4 weeks post treatment

Parameters	Infested control	Non In-fested control	Albendazole		Ivermectin		Moxidectin	
			2w	4w	2w	4w	2w	4w
RB Cs x 106/ul mean:	8.16	10.14**	8.74*	9.22**	8.90*	9.32**	8.97*	9.98**
S.D.	± 0.507	± 0.296	±0.317	± 0.490	± 0.159	± 0.7	± 0.353	± 0.403
Hb gm/dl mean:	9.01	10.75*	9.44*	10.01*	9.52	10.41*	9.60*	10.54*
S.D.	±0.707	±1.079	±0.313	*0.328	± 0.425	± 0.404	± 0.534	± 0.604
PCV % mean:	29.324	32.26**	30.01	31.72*8	30.418**	31.97**	30.61*	32.11**
S.D.	±0.735	±1.136	*0.825	±0.483	± 0.547	± 0.394	± 0.446	± 0.481
W B Cs 103 / ul mean:	10.19	9.72	10.11	9.92	10.01	9.85*	9.95	9.75
S.D.	±0.675	±0.634	*0.419	± 0.994	± 0.585	± 0.504	± 0.558	± 0.266

Table 9: Differential leucocytic count of non infested and infested sheep Before and at 2 and 4 weeks post treatment

Parameters	Infested control	Non In-fested control	Albendazole		Ivermectin		Moxidectin	
			2w	4w	2w	4w	2w	4w
Eosinophils % mean:	6.1	5.40**	5.85*	5.7	5.74	5.44*	5.69*	5.41**
S.D.	± 0.623	± 0.584	±0.222	± 0.584	± 0.307	± 0.15	± 0.227	± 0.239
Neutrophils % mean:	37.92	30.23*,*	35.21*	32.04**	34.16**	31.72*	34.01**	30.90*
S.D.	± 0.555	± 0.619	± 0.286	± 0.619	± 0.079	± 0.487	± 0.974	± 0.235
Lymphocytes% mean:	53.26	63.22**	57.03**	61.13**	59.31**	63.00**	59.98**	63.02**
S.D.	± 0.530	± 0.456	*0.925	± 0.877	± 0.298	± 0.502	± 0.408	± 0.276
Monocytes % mean:	3.31	2.50*	3.11	2.36**	2.95	2.51*	2.48**	2.71
S.D.	± 0.312	± 0.434	± 0.166	± 0.425	± 0.677	± 0.524	± 0.471	± 0.281

Table 10: Biochemical parameters of non infested and infested sheep. Before and at 2 and 4 weeks post treatment

Parameters	Infested control	Non In-fested control	Albendazole		Ivermectin		Moxidectin	
			2w	4w	2w	4w	2w	4w
Serum total protein:	6.51	7.11*	6.71*	6.98	6.84	7.01*	6.92*	7.10*
S.D.	± 0.280	± 0.539	± 0.378	± 0.745	± 0.367	± 0.715	± 326	± 0.540
Serum albumin mean:	1.39	2.38**	1.77**	2.26**	1.96**	2.31**	2.18**	2.37*
S.D.	± 0.208	± 0.253	± 0.0213	± 0.265	± 0.207	± 0.251	± 0.155	± 0.267
Serum globulin: S.D.	4.98	4.54*	4.71**	4.66**	4.68*	4.61*	4.59*	4.56*
	± 0.200	± 0.47	± 0.56	± 0.56	± 0.350	± 0.442	± 0.362	± 0.36

as 2 days. This result agreed with that obtained by Craige *et al.*, (1992), Pankavich (1992), Bauer and Conraths (1994), Coles *et al.*, (1994), Kerboeuf *et al.*, (1995), and Tuzer *et al.*, (1999). On contrary Leathwick (1995) observed a failure of both Ivermectin and Moxidectin (orally drenched at dosage rate 0.2 mg/kg BW) to reduce faecal egg counts of the resistant *Ostertagia spp.*

Our trial results revealed that, the comparative effectiveness of the three drugs was best for the Moxidectine treated group followed by the Ivermectine treated group then Albendazole treated group. Variation in egg count reduction may be attributed to some resistance in sheep gastrointestinal nematodes for anthelmintics.

Concerning of blood picture of sheep naturally infested with gastrointestinal nematodes results revealed significant decrease of RBCs count, hemoglobin

content and PCV (8.16 million/ul, 9.01 gm/dl and 29.7 respectively) compared non infested group (10.14 million/ul, 10.74 gm/dl and 32.26 respectively) especially in hemonchosis cases.

Nearly similar results were reported by Deghedy (1981), El-Faamy (1989), Mottelib *et al.*, (1992), and Maiti *et al.*, (1999). On cotary Abd- All (1990) reported a decrease in TWBCs within infested sheep whereas Moskwa *et al.*, (1989) reported that there was no significant change in TWBCs, and this dissimilarity may be attributed to differences in species of the parasites or other factors.

The leucocytosis was mainly attributed to eosinophilia as eosinophils percent in infested animals was (6.10) while that of noninfested control (5.4). The eosinophilia could be attributed to the reaction of the host against the invaded parasite or may

be due to a sensitivity of the host against secretory products of the parasite as reported by Schalm *et al.*, (1963). More over the eosinophils may phagocytose the antigen antibody complex and play an important role in the defense mechanism of the different organs and tissues of the host against parasite Sabesin (1963).

The results revealed also significant *neutrophilia*, *eosinophilia*, and *monocytosis* while lymphocyte percent decreased significantly with infestation (*lymphopenia*). These results agreed with El-Faomy (1989), Mottelib *et al.*, (1992), and Maiti *et al.*, (1999). After treatment, the blood picture parameters of infested animals were nearly returned to normal, 30 days post treatment.

Regarding biochemical parameters of blood serum, we noticed a significant decrease in both serum total proteins and albumin in infested animals (6.51 gm/100ml and 1.39 gm/100 ml) compared to (7.11 gm/100ml and 2.38 gm/100 ml) while serum globulins significantly increased with infestation (4.98 gm/100ml) compared to (4.57 gm/100ml) in control non infested animals.

Similar findings were obtained by Shawkat *et al.*, (1991), Mottelib *et al.*, (1992), El-Sawalhy and Hassan (1996), and Maiti *et al.*, (1999).

El-Sawalhy and Hassan (1996) proved that, the decreased mean values of the total proteins and albumin percent in era of infested sheep (6.05 ± 0.13 and 36.9%) respectively were nearly returned to normal, 14 days post treatment whereas the increased total globulin percent (63.10%) was nearly decreased to the normal values 14 days post treatment. The integrated function of the alimentary tract due to decreased absorption of nutrients from sites of infestation, damage caused by parasite, intestinal cells sloughing and consumption of digested nutrients by the parasites may be the causes of decrease of such values. Poppi *et al.*, (1986) gave such an explanation. The lower percentage of albumin in infested sheep may attribute to liver and kidney

function disturbances Coles (1974). The reduced dietary protein availability leads to growth stuning and osteoporosis even with subclinical burdens Coop and Jakson (2000).

In conclusion, although moxidectin is efficacious for therapy of gastrointestinal nematodiasis it seems impossible to control parasitic infections without correction of production system and welfare of our sheep as well as finding other natural and biological methods for control as; reliance on anthelmintics alone may not provide the most effective and economic control.

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A SURVEY OF SCHISTOSOMA BOVIS IN CATTLE IN KWALE DISTRICT KENYA.

Kamanja IT¹, Githigia S M^{2*}, Muchemi G M³, Mwandawiro C⁴.

¹Ministry of Livestock Development, Animal Health and Industry Training Institute (A.H.I.T.I.)
P.O.Box, 1 Nyahururu

²Department of Veterinary Pathology, Microbiology and Parasitology, Faculty of Veterinary Medicine, University of Nairobi, P.O.Box 29053, 00625 Nairobi

³Department of Public Health, Pharmacology and Toxicology, Faculty of Veterinary Medicine, University of Nairobi

⁴Eastern and Southern Africa Centre for International Parasite Control (ESACIPAC) Kenya Medical Research Institute (KEMRI), Nairobi

Abstract

A study was carried out to determine the prevalence and possible public health importance of *Schistosoma bovis* in cattle in Kwale District. Abattoir surveys were carried out where the mesenteric veins of the carcasses were visually examined for the presence of adult *S. bovis* worms. Three abattoirs were visited. These were Ngombeni and Kwale slaughter houses in Matuga division and Mwambungo slaughter house in Msabweni division. Identification of *S. bovis* eggs was done after sedimentation of rectal faecal samples. A total of 492 samples from various divisions in the district were analyzed. Snails were sampled using the scooping method in the water bodies and digging in riverbeds. They were put in 24-well microtitre plates under the shade for at least two hours to induce shedding of cercariae. Stool and urine samples from school going children from Matuga Msabweni and Kinango divisions were analyzed for *S. bovis* eggs. The prevalence of *S. bovis* eggs as 16.9% while the prevalence of *S. bovis* adult worms was 25.1%. Snails of the genus *Bulinus* were recovered from the various water bodies. No *S. bovis* eggs were recovered from the stool samples. Eggs of *S. haematobium* were recovered from urine samples. Polymerase chain reaction (PCR) confirmed that the adult worms recovered from slaughtered cattle were *S. bovis*. It was concluded that *S. bovis* is prevalent in cattle in Kwale district. The water bodies were infested with the snail intermediate host.

Key words: *Schistosoma bovis* prevalence polymerase Chain Reaction.

ENQUÊTE RELATIVE À LA DÉTERMINATION DE LA PRÉVALENCE DE SCHISTOSOMA BOVIS CHEZ LES BOVINS DU DISTRICT DE KWALE (KENYA)

Résumé

Une étude en matière de santé publique dont l'objectif était de déterminer la prévalence et l'importance éventuelle, de *Schistosoma bovis* chez les bovins du district de Kwale a été réalisée dans cette unité administrative. Des études ont été menées dans des abattoirs où les veines mésentériques des carcasses ont été observées à l'œil nu, dans la perspective de déceler la présence des vers adultes de *Schistosoma bovis*. Parmi les trois abattoirs où se sont déroulées les opérations d'identification du verre figurent ceux de Ngombeni et Kwale dans l'arrondissement de Matuga, et celui de Mwambungo dans l'arrondissement de Msabweni. La sédimentation des échantillons de matières fécales prélevées à partir du rectum a permis de confirmer la présence des œufs de *Schistosoma bovis*. L'équipe de recherche a analysé un total de 492 échantillons récoltés à travers différents arrondissements du district. Pour le prélèvement des mollusques qui sont les principaux vecteurs de ce parasite il aura fallu écopier les cours d'eau et creuser les lits des rivières. Les

*Corresponding author, Email address sgithigia@uonbi.ac.ke

mollusques recueillis sont conservés dans des plaques de microtitration à 24 puits mises à l'abri de la lumière pour 2 heures au moins, en vue de faciliter la libération des cercaires. Les prélèvements de selles et d'urines effectués chez de jeunes écoliers des arrondissements de Matuga, Msabweni et Kinango ont été analysés aux fins de mise en évidence des œufs de *Schistosoma bovis*. La prévalence des œufs de *Schistosoma bovis* a été de l'ordre de 16,9% parallèlement à celle des vers adultes de *Schistosoma bovis* quantifiée à 25,1%. Les vecteurs du genre *Bulinus* vecteurs de schistosomiasis humaines et animales ont été retrouvés dans plusieurs cours d'eau. Les résultats de l'analyse des échantillons de selles n'ont pas décelé la présence des œufs de *Schistosoma bovis*. Ce sont par contre des œufs de *Schistosoma haematobium* qui ont été repérés dans les prélèvements d'urines. La réaction en chaîne par polymérase a confirmé que les vers adultes retrouvés dans les échantillons de matières fécales de bovins abattus étaient des *Schistosoma bovis*.

Selon la conclusion tirée de cette enquête, la prévalence du *Schistosoma bovis* chez les bovins du district de Kwale est avérée. Les cours d'eau de cette localité sont infestés de gastéropodes vecteurs de ce parasite

Mots clés: *Schistosoma bovis*, Réaction en chaîne par polymérase.

Introduction

Schistosomosis is caused by flukes of the genus *Schistosoma*, the adult stages of which are found in the blood vessels of the vesical plexus or the hepatic portal system of the vertebrate host. Ruminant *Schistosoma bovis* is widespread in Africa, the Mediterranean and the Middle East (Dinnik and Dinnik, 1965), Johansen, (1994). In some countries such as the Sudan, the prevalence of *S. bovis* infection in cattle in the enzootic areas may be high, ranging between 37.2% and 90.8% (Dinnik and Dinnik, 1965), and being highest in 18 month old cattle (Majid, et al., 1980). Although cattle naturally infected with *S. bovis* do acquire immunity as manifested by a decline in prevalence and intensity of infection with increase in age (Majid et al., 1980), this resistance may be achieved at the expense of considerable morbidity and mortality in the young calves Hussein, (1980). *Schistosoma bovis* infection may remain as a long standing chronic infection, with low morbidity but causing continuous ill health and low productivity in affected herd (Makundi, et al., 1998).

Schistosomes are important parasites because of their medical and veterinary importance. Domestic livestock have been reported to harbour natural infections of medically important schistosomes including *S. bovis* (Rollinson and Southgate, 1957)

Although *S. bovis* is primarily a ruminant schistosome it has been isolated from human stool (Raper, 1951, Kisner, et al., 1953, Chunge, et al., 1986). This however, may not necessarily suggest human infection with *S. bovis* but could be a case of spurious infection (Kinoti and Mumo, 1988).

Schistosomes use fresh water snails as intermediate hosts and hence creation of large man made dams for hydro-electric power generation and the establishment of irrigation schemes for farming will increase habitats for aquatic snails and risk of schistosomosis for both livestock and humans. An example is Mwea Rice Irrigation Scheme where high prevalence of *S. mansoni* has been reported since the initiation of the irrigation project (Doumenge et al., 1987). Kwale District in Coast Province has low lying areas and seasonal rivers which get flooded during heavy rains but stagnant water masses persist during the dry season. Damming activities in these areas create conditions favourable for habitation by fresh water snails of both veterinary and medical importance. These water systems are used by humans and animals making conditions conducive for occurrence of snail borne diseases like *schistosomosis*.

Schistosoma haematobium which is in the same species group as *S. bovis* is also common in Kwale district (Mkoji, et al., 1999). Fresh water snails of the genus *Bulinus*,

the intermediate hosts for schistosomes species in the *S. haematobium* group are present in this area (Hansen and Perry 1994). These predispose to the presence of *S. bovis*. Although extensive studies have been undertaken on *S. haematobium* in the human population in Kwale, very little is known about *S. bovis* in this area. This study was carried out to determine the prevalence of *S. bovis* in cattle in Kwale district.

Materials and Methods

Study area

Kwale District is one of the seven districts of Coast Province. It borders Taita Taveta District to the west, Kilifi District to the northwest, Mombasa District and Indian Ocean to the east and the Republic of Tanzania to the south. The district is located in the south eastern corner of Kenya lying between latitudes 303' and 4045' south and longitudes 38031' and 39031' east. It has an area of 8260 km² of which 62 km² is under water. The area excludes the 200 mile coastal strip known as the exclusive tourism zone.

The district is divided into 5 administrative divisions namely Matuga, Kubo, Msabweni, Kinango and Samburu. The district has a bimodal type of rainfall. The short rains occur between October and December while the long rains occur between March/April and July. Total precipitation varies from 900 – 1500 mm per annum along the coast to 500 – 600 mm in the hinterland. Average temperatures ranges from 26.3°C to 26.6°C in the coastal lowlands and 24.6°C to 27.5°C in the hinterland. The study was carried out between March and September 2005.

Experimental design

The study locations were purposively selected abattoirs and various watering points and some selected farms. The farms selected were those close to the water bodies.

Collection and examination of cattle faecal samples

Individual rectal faecal samples were collected from herds of cattle in the selected farms. They were labeled and transported in cool boxes to Kwale KEMRI Laboratory for analysis using the sedimentation technique (Hansen and Perry, 1994). Rectal faecal samples were also taken from slaughtered animals at the abattoir and analysed as above. Any other helminth ova were noted and recorded.

Collection of stool and urine samples

Collection and examination of human stool and urine was done under the Eastern & Southern Africa Centre of International Parasite Control (ESACIPAC) school children deworming programme protocol. Three schools, one from Msabweni, Matuga and Kinango divisions were visited and standard three pupils with an average age of 9 years were selected for sampling. Stool samples were analysed for *S. bovis* eggs using the Kato-Katz method (Idris and Jabril, 2001) while urine samples were analysed using the filtration technique Bell, (1963).

Snail sampling studies

Snail sampling studies were carried out at selected animal watering points using the scooping method. The sites included Kinango dam, Kandigo stream, Bangoni river, Manola river, Ziwani dam and Zigira dam. Morphological characteristics were used to identify the genus (Stothard, et al., 1997). The snails were put in 24-well microtitre plates under the shade for at least two hours to induce shedding of cercariae.

Abattoir surveys

Sampling was done at selected abattoirs in the district. A total of 336 slaughtered animals from Ngombeni, Kwale and Mwabungo abattoirs were visually examined for the presence of *S. bovis* adult worms in the mesenteric veins. The worms were removed and preserved in 70%

alcohol for further studies. Polymerase chain reaction (PCR) was used for confirmation of adult *S. bovis* worms. This was done by schistosome DNA extraction followed by its digestion with *sau3AI* enzyme and subsequent agarose gel electrophoresis (Barber *et al.*, 2000)

Data analysis

The statistical programme, InStat (R) version 2.51 (Stern *et al.*, 2002) was used for analysing the data. A one way Analysis of Variance (ANOVA) was used to compare the difference in frequencies of the number of animals infected for the different sexes and age groups of the sampled animals and to check for any significance of the differences in frequency of the parasite. A graphical presentation was used to compare frequencies of infections over the study period.

Table 1: Prevalence of *S. bovis* eggs in faecal samples of cattle from four divisions in Kwale District

	No. examined	No. infected	Parasite prevalence (%)
Kinango	174	25	14.4
Msabweni	60	10	16.7
Matuga	70	21	30
Kubo	65	15	23.1
Total	492	83	16.9

Results

Rainfall pattern in Kwale District

The rainfall pattern during the study period was lower than the average rainfall expected. The months of May to July were wet while March, August and September were dry. The highest rainfall was received in May while March had the lowest.

Faecal sample analysis for *S. bovis* eggs

A total of 492 cattle faecal samples were examined during the study period. Out of these 83 were positive for *S. bovis* which gave a point prevalence of 16.9%. The prevalence varied between the divisions.

Kinango division had a prevalence of 14.4%, Msabweni 16.7%, Matuga 30%, Kubo 23.1% and Kwale slaughter house 9.8% (Table 1). The difference in prevalence between the administrative divisions was statistically significant ($P < 0.05$).

The prevalence of *S. bovis* eggs varied with age, the age group below 3 years being 18.1% while the age group between 3 to 6 years had a prevalence of 12.0%. The age group above 6 years had a prevalence of 21.1%. However, these differences were not statistically significant ($P > 0.05$).

The prevalence also differed with the sex of the animals. The female animals showed a slightly higher prevalence of (17.4%) than the males which showed a prevalence of (15.3%). However, these were not statistically significant ($P > 0.05$).

Prevalence of adult *S. bovis*

Ngombeni slaughter house had a prevalence of 16.3%, Kwale had a prevalence of 28.7% and Mwabungo had a prevalence of 10.5%. The overall prevalence in the three abattoirs was 25.1%. The differences between the slaughter houses were not statistically significant.

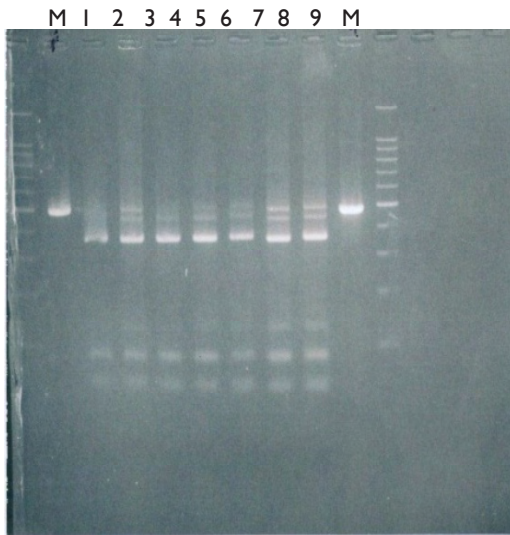
The parasite incidences also varied between study months (March to September) with highest incidence being observed in May and the lowest in September. The differences were not statistically significant $P > 0.05$. During the abattoir survey other trematodes were also recovered from slaughtered cattle, and these included conical flukes (Paramphistomes) in the rumen and liver flukes (*Fasciola gigantica*) in the liver. Adult conical flukes were more common than either liver flukes or blood flukes.

Snail sampling survey

Results are shown in Table 2. In Manola and Bangoni rivers during the dry season snails were seen only after digging into the sandy riverbeds while, at Zigira and Kinango dams no snail of the genus *Bulinus* were found. Kandingo stream showed a higher population of the snails. During the

Table 2: Relative abundance of *Bulinus* snails in different water bodies surveyed in Kwale

Water body	No. of snails per water body
Kinango dam	0
Zigira dam	352
Ziwani dam	0
Manola river	74
Bangoni	50
Kandigo stream	320
Total	696

Figure 1: Agarose gel picture showing RFLP patterns produced by electrophoresis.

wet period the snail population increased in the water bodies. Other species of snails found in the study water bodies in Kwale included the genera *Lanistes*, *Melanoides* and *Cleopatra*.

School children stool and urine samples

All the stool samples were negative for *S. bovis* eggs. Three urine samples from the pupils were positive for *S. haematobium* eggs. Other helminth parasites identified in stool samples included *strongyle* spp, *Ascaris* spp, hookworms and *Trichuris* spp.

Confirmation of the identity of the adult S. bovis

This was confirmed by the PCR-RFLP assay (Barber, et al., 2000) Restriction

fragment length polymorphism (RFLP) analysis of the 480 bp fragment of the ITS2 using the restriction enzyme *Sau3A1*, yielded fragment patterns on an agarose gel after electrophoresis and staining with ethidium bromide indicated the worms were *S. bovis* (Figure 1). In this assay *S. bovis* can be differentiated from *S. haematobium*. These results showed that the adult worms that were recovered from slaughtered cattle in Kwale district were *S. bovis*.

Discussion

Schistosoma bovis is present in cattle in Kwale District and its prevalence in the present survey was 16.9% in faecal samples. Cattle below 3 years age and above 6 years old had higher prevalence of infection than those between 3 to 6 years. These findings closely agree with those of cattle in Southern Sudan (Majid et al., 1980) and Iringa District, Tanzania (Makundi, et al., 1998)

It has been suggested that immune suppression operating in animals observed as lowered fecundity in worms in animals between 3-6 years of age may be the mechanism involved in the development of acquired resistance to *S. bovis* infection in cattle in this age group (Niel et al., 1980). The higher prevalence in the younger age groups (< 3 yrs) does suggest that this age group is more susceptible to schistosome infection and lacks a fully developed immune system against the trematode infection. The rise in the faecal egg excretion in the older cattle of over 6 years is probably due to a "breakdown" in the immune system in this age group (Makundi et al., 1998)

Relative snail abundance varied from place to place and from season to season. No snails were present in the water habitats in the drier months of the year hence a lower incidence of the parasite in these months than the wet ones. Snails occur in great abundance during the wet months, and that is the time infected snails are likely to be present. On the other hand during the dry months fewer snails are present and the possibility of getting infected snails is also

much lower. During the drier months the sporocyst development and maturation in the snail is arrested as the snails aestivate. Development of sporocyst resume during the wet season when conditions are more favourable for transmission (Niel, *et al.*, 1980).

The temperatures during the wet season are more appropriate for miracidial and cercarial emergence from the eggs and snails, respectively and their survival while during the dry period the miracidia and cercariae survival is minimal (Niel, *et al.*, 1980). This may also explain the difference in incidence of the parasite over the wet and dry seasons. The fecundity of the female worms is higher over the wet period than over the drier periods and hence the higher incidence of the parasite in the wet season (Noda, *et al.*, 1994).

The prevalence of adult *S. bovis* worms in slaughtered carcasses in Kwale district was 25.1%, and this prevalence compares with those observed in abattoir surveys on *S. bovis*, 23% in Masailand (Kajiado and Narok districts) and 25% in Ukambani (Machakos and Kitui districts) (Dinnik and Dinnik, 1965).

During the study period from March to September 2005, Kwale experienced dry months in March, June, and September and wet months in May, July and August. The prevalence of infection was low during the dry months and higher during the wet months.

The prevalence increased with the onset of rains in April and peaked in May when the rains were heavier but progressively decreased with lowered rainfall towards September. This pattern can be explained by the host parasite relationship where, the parasite adapts itself according to the host internal environment. When there is abundant feed the parasite reproduces more of its offspring as there are better chances of survival and reproduction is low when feed availability is low (Niel, *et al.*, 1980).

Further analysis of adult worms using molecular techniques indicated that the

adult parasites recovered from slaughtered cattle in Kwale district were *S. bovis*. These results agree with earlier reports that worms recovered from slaughtered bovines in different parts of Kenya were *S. bovis* (Barber, *et al.*, 2000)

The snail intermediate hosts of *S. bovis* the pulmonate snails of the genus *Bulinus* were present in the water bodies studied in Kwale District in large numbers in some of the sites, while they were absent in others. The snail abundance showed seasonal variations. Snail abundance was lower during the dry months but higher during the wet months. Snail populations therefore, increased with the onset of the wet months, and declined during dry months when the snails aestivated to avoid extreme weather conditions (Niel, *et al.*, 1980). These findings are in agreement with previous observation on seasonal variations in snail population in Kwale (Noda, *et al.*, 1994).

The absence of *Bulinus* and other pulmonate snails in some water bodies could in part be attributed to the presence of prosobranch snails that are thought to be predators and competitors of pulmonate snails, and therefore, potential biological control agents for schistosome transmitting snails (Hofkin, *et al.*, 1991, Mkoji, *et al.*, 1992, Loker, *et al.*, 1993) The mesenteries are usually sold at the local markets as "matumbos" (tripes) whether infected or not. This then makes *S. bovis* to be of Public health importance because infected meat is passed for human consumption which may cause either transient infection Raper, (1951) or spurious infection (Kinoti and Mumo, 1988).

Conclusions

The prevalence of *S. bovis* in Kwale district was 16.9% in faecal samples and 25.1% in slaughtered cattle. The age groups below 3 years and above 6 years were shedding more eggs and therefore require more attention when carrying out any helminthes

treatment programme at the farm level and since the prevalence of the parasite is also high during the rainy season its important to treat the animals strategically just before the rains.

The snail intermediate host, genus *Bulinus*, is present in various water bodies in the district and therefore measures can be instituted to control the snails.

Since *S. bovis* share the intermediate hosts with *S. haematobium* then control of this snail may control both *S. bovis* and *S. haematobium* and this would be beneficial from both a public health and economic point of view.

Impact

Although cattle naturally infected with *Schistosoma bovis* do acquire immunity as manifested by a decline in prevalence and intensity with increase in age this resistance maybe achieved at the expense of considerable morbidity and mortality in the young calves. *Schistosoma bovis* infection may remain as long standing chronic infection, with low morbidity but causing continuous ill health and low productivity in affected herds.

The most affected age groups therefore require more attention when carrying out helminthes treatment programme at the farm and during the rainy season strategically deworm the animals. Slaughter houses should be used as points to check on deworming programmes among the farmers

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EPIDEMIOLOGICAL STUDIES ON BOVINE BABESIOSIS

Salm F F¹, Younis E E², Hegazy N M³ and El-Sawalhy A A⁴

¹Veterinary Teaching hospital Fac. Vet. Med., Mansoura University, Egypt

²Dep. Internal med. and infectious disease Fac. Vet. Med., Mansoura University, Egypt

³Veterinary Serum and Vaccine Research Institute, Abbasia, Egypt

⁴African Union/Interafrican Bureau for Animal Resources (AU-IBAR),

Summary

This study carried out at Dakahlia and Daimetta provinces in Nile Delta, Northern Egypt, 650 cattle of different ages (all of them were over six months) were investigated. Of them 234 were considered as suspected cases from which the peripheral blood smears were examined microscopically. The prevalence of *B. bigemina* through Giemsa stained blood smears positivity was found to be 7.69 %. All stained blood smears were negative for *B. bovis*. Blood smears positivity cleared a seasonal pattern and an age profile with significant differences. In sporadic farmers and small holders sector at Dakahlia province; seroprevalence by IFAT for *B. bigemina* was 47% indicative of a situation of endemic instability with significant clinical disease risk. This is consistent with clinical cases of babesiosis that diagnosed through stained blood smears and the indiscriminate tick control practices in these two sectors. On the other hand, the tick control programmes were more aggressive and sustained with good results in intensive farms at Daimetta province leading to a minimal disease situation.

Key words: prevalence, *B. bigemina* Giemsa, peripheral blood smears, Egypt

ETUDES EPIDEMIOLOGIQUES SUR LA BABESIOSE BOVINE

Résumé

La présente étude a été réalisée dans les provinces de Dakahlia et de Damiette de la Région du Delta du Nil, au Nord de l'Égypte. Les travaux de recherche ont porté sur 650 bovins d'âges différents, mais supérieurs, pour l'ensemble d'entre eux, à 6 mois. Parmi les animaux sélectionnés, 234 ont été considérés comme des cas suspects et leurs frottis de sang périphérique ont été analysés au microscope. La méthode de coloration panoptique de frottis sanguin de Giemsa a permis de détecter et d'identifier, chez ces bovins, un taux de prévalence de *Babesia bigemina* de l'ordre de 7,69 %. Tous les frottis sanguins colorés ont été reconnus négatifs au *Babesia bovis*. La réaction positive des frottis sanguins a permis de mettre en lumière le caractère saisonnier de l'épidémie de babésiose bovine et un profil d'âge présentant des différences notoires entre les bovins. Dans le secteur des éleveurs sporadiques et des petits exploitants agricoles de la province de Dakahlia, la séroprévalence au *Babesia bigemina* estimée à 47% selon la méthode sérologique de l'immunofluorescence indirecte (IFAT) a permis de se rendre compte de la situation d'instabilité endémique accouplée au risque de maladies cliniques qui prévaut dans le secteur. Ce constat concorde effectivement avec les cas de babésiose diagnostiqués à travers les pratiques de frottis sanguins colorés et de contrôle systématique contre toutes les espèces de tiques dans les deux secteurs. D'autre part, les programmes de lutte contre les tiques ont été plus agressifs et constants et ont abouti à des résultats satisfaisants dans les élevages intensifs de la province de Damiette entraînant ainsi une réduction, au strict minimum, des cas de maladie.

Mots cles: Prevalence, *B. bigemina* Giemsa, coloration panoptique, Égypte

Introduction

Cattle are the most important type of livestock in Egypt. Foreign breeds of cattle are imported and reared for milk production in dairy intensive systems whereas native and/or foreign breeds are reared by farmers and smallholders for providing milk and meat.

Unfortunately, the contribution of our cattle production to human nutrition is dis-proportionally low. Absence of judicious political and institutional agendas has been led to a number of factors limiting development of the dairy industry and these include unprofitable investment in livestock industries, inappropriate technologies, poor management, and diseases.

Bovine babesiosis, caused by hemoprotozoa *Babesia bovis* and *Babesia bigemina* are responsible for important economical losses in cattle industry of tropical and subtropical areas of the world (Grisi *et al.*, 2002)

The economical impact is a consequence of direct losses, such as mortality, reduction in meat and milk yield, and indirect ones with the application of control measures. The most relevant pathogenicity aspect of these hemoparasites is the marked anemia that leads to high percentage of mortality in non-immune cattle herds (Kessler & Schenk 1998)

However, positive serological reactions to *B. bigemina* and *B. bovis* could be used as indicator of the existence of immunity to these parasites (Hall, 1960; Mahoney, 1967)

The principle of endemic stability to TBDs was first mooted by Mahoney & Ross (1972) in Australia, using *Babesia bovis* in *Boophilus microplus* as an example. They stated that if the inoculation rate of the protozoa by the tick into cattle is sufficiently high, then all calves would be infected whilst still protected by age resistance. Clinical disease would be minimal and endemic stability would be achieved. If, however, the inoculation rate is not sufficiently high,

calves would not be immunized before they lose their age resistance and clinical cases would result. With low tick numbers disease transmission is interrupted, resulting in minimal disease. Epidemiological models have suggested that reduction in acaricide treatment frequency to permit high tick-attachment rates allows the development of 'endemic stability' (Norval *et al.*, 1992) under which mortality and morbidity due to tick-borne diseases would be reduced (Medley *et al.*, 1993; O'Callaghan *et al.*, 1998).

In Egypt where ticks and tick-borne diseases currently exist and there is consensus on the significant economic impact of these diseases, there is no doubt about the need for some sort of tick control. Epidemiological studies are fundamental as a basis for tick management plan.

The epidemiological data of such diseases in Egypt has not been described enough to compile information on the local epidemiological patterns and its relation to endemic stability or instability. Therefore we are interested in determination the prevalence of bovine babesiosis in cattle populations in the study area and assessment of the endemic status by using the seroprevalence values and its effect on the clinical reaction.

Materials and Methods

Cattle and study area:

The study was conducted between June 2005 and June 2007 on cattle at Dakahlia and Daimetta provinces in Nile Delta, Northern Egypt, representing a wide diversity of breeding systems.

For determination, the current existence of bovine babesiosis in cattle populations in the study area, in Dakahlia province 650 cattle of different ages (all of them were over six months) were examined according to (Kelly 1994),

416 of them were apparently healthy and 234 of them were suspected cases. In Daimetta province, 4640 cattle were investigated, 976 of them were suspected.

From suspected cases the peripheral blood smears were examined microscopically. We considered feverish animals (temperature over 40°C) infested with ticks or not and cattle infested with tick feverish or not as suspected cases. Ticks on these animals that may implicated as a vectors were collected for identification.

For characterization the risk of babesiosis in the study area, we sampled 350 cattle all of them over 24 weeks for seroepidemiological survey and assessing endemic stability (100 from sporadic field cases and small holders randomly selected and 250 from intensive system farms). Sampled cattle were selected to represent different locations and production systems currently existed.

Managemental characteristics:

For collecting wider farm data managemental characteristics for different production systems for analysis of seropositivity to bovine babesiosis and its relation to endemic stability or instability; we designed a questionnaire, which administered on visited farms, smallholders and household cattle owners. The questionnaire was designed to include mostly closed ended questions to ease data processing, minimize variation and improve precision of responses in accordance with (Thrusfield 2000).

Management system was categorized into three groups according to the flock size (FS) and the nature of management: Farmers (FS 1-5 Heads), Traditional Breeders (5<FS <100 Head) and Intensive System (FS>100 Head). Most of the cattle kept in the study area for farmers and small holders are mixed crosses whereas in intensive farms, most of the cattle kept are of high-performance as Friesian, Holstein, Swiss Brown, and Simental. Native cattle represent a very few proportion of cattle stocked by farmers.

Most farmers and traditional breeders practice tick control measures in irregular indiscriminate manner for tick

control. Some use acaricide treatment. Butox® or Diazinon® through hand washing or spraying, some use ivermectin injection, and others use ethnoveterinary methods as removal ticks by hand and using ghee or engine oil as an acaricide. Some farmers use more than one measure at the same time and others didn't practice any form of tick control practices. In addition there were governmental spraying campaigns (1-2 times) during summer season. On the other hand, the tick control programmes were more aggressive in intensive farming. The owners of investigated four farms were controlled ticks using the acaricide belonging to the group of Deltamethrin (12.5 mg) (Butox®) by spraying at different frequencies ranging from 2 weeks interval in summer and 8 weeks in winter season. The program had been sustained with good results.

Samples:

Blood smears from 234 cattle in Dakahlia province and 976 in Daimetta province were taken from capillary venous blood of the tip of ear. Blood were collected aseptically from (350 cattle) from the jugular or coccygeal veins in sterile serology tubes using 20-gauge needles without anticoagulant for serology testing purpose. Serum samples were stored at -20°C until used. Tick samples from suspected cattle were taken for tick identification.

Examination of blood films:

The blood smears examined about ¼ or ½ inch from the end of the film and transversed from one side of the films of the other (cross-sectional-method) to give a constant and representative sample according to (Barrent, 1965).

IFAT:

IFAT was done for estimation of antibodies titers on collected sera according to Akinboade and Dipelu (1984) and Hegazy *et al.*, (2003).

Tick collection and identification:

Each suspected animal was carefully checked for ticks and tick specimens were placed into 70% ethanol in a single glass vial for an individual animal. Ticks were identified according to the keys of Hoogstraal and Kaiser (1956).

Results and Discussion

Parasitological findings

Babesia bigemina were diagnosed as their typical pear-shape paired forms, but many diverse single forms were found. All examined stained blood smears were negative for *B. bovis*. This is probably because the lower infectivity of *B. bovis* for ticks due to its lower parasitaemia levels, since the ability of the tick vector to acquire *B. bovis* from a persistently infected animal is influenced by the level of parasitaemia

during feeding. This is consistent with nearly all Egyptian workers with exception of Abd-El Gawad (1993) who reported an incidence 1.66% for *B. bovis* in cattle by stained blood smears. Our result is similar to those from South Africa by Mtshali *et al.*, (2004).

*Epidemiological findings**Prevalence of babesiosis based on blood film*

In sporadic field cases and small holders sector, out of 650 investigated cattle 234 of them were suspected from which 50 animals (7.69%) were infected with *B. bigemina*. In intensive system farms, out of 4640 investigated cattle 976 of them were suspected from which 21 animals (0.45%) were infected with *B. bigemina*.

Prevalence of bovine babesiosis based on blood film related to the area and production system.

Table 1: Prevalence of babesiosis based on blood film

Breeding system	Locality	Animals at risk	Positive blood smear for <i>B. bigemina</i>	
Sporadic field cases and small holders*	E.V.H.C#	208	18	8.65%
	El-Mansoura	211	16	7.58%
	Dikrnis	90	7	7.78%
	El-Senbellawin	92	6	6.52%
	Bilkas	49	3	6.12%
	Total	650	50	7.69%
Intensive system farms**	Ras elbar	960	4	0.42%
	Daimetta	3680	17	0.46%
	Total	4640	21	0.45%

Educational Veterinary Hospital Clinic, Mansoura University

There a significance variation at $P < 0.001$ between sporadic field cases and small holders sector and intensive system farms sector.

Table 2: Seasonal dynamics of blood smear positivity for *B. bigemina*:

Season	Small holders			intensive system farms		
	Animals at risk	Positive <i>B. bigemina</i>		Animals at risk	Positive <i>B. bigemina</i>	
		No.	%		No.	%
Summer	165	25	15.15%	1200	8	0.67%
Autumn	160	10	6.25%	1130	5	0.44%
Winter	160	3	1.88%	1160	2	0.17%
Spring	165	12	7.27%	1150	6	0.52%

Significance variation at: $P < 0.001$

In small holders sector, stained blood smears positivity cleared that there is significant season-dependent differences were observed as the highest prevalence for *B. bigemina* was in summer (15.15%), followed in spring (7.27%), then in autumn (6.25%), and with the minimum prevalence (1.88%), in winter, in a pattern similar to that reported previously by many Egyptian workers as Ahmed (1980) and Sakla, (1975). This pattern is consistent with the climate of the study area where summer is the hottest season followed by spring whereas autumn is the mildest season and winter is the coldest one. In intensive farms, the same pattern was occurred for *B. bigemina* prevalence but the variation not significant. Effect of age on the prevalence of *B. bigemina*

With respect to age categories, blood smear results revealed that age category 1-2 year showed the highest blood smear positivity for *B. bigemina* 19/165 (11.52%) in sporadic field cases and small holders whereas in intensive system farms it was 9/1200 (0.75%) In age category 2-3 year it was 15/165(9.09%) in sporadic field cases and small holders whereas in intensive system farms it was 6/1180 (0.51%). In age category >3 year, it was 13/160 (8.13%) in sporadic field cases and small holders whereas in intensive system farms it was 5/1160 (0.43%). On the other hand the lowest blood smear Positivity for *B. bigemina* was obtained in age category 6-12 months 3/160 (1.88%) in sporadic field cases and small holders whereas in intensive system farms it was 1/1100 (0.09%).

Table 3: Effect of age on the prevalence of *B. bigemina*

Age categories	Small holders			intensive system farms		
	Animals at risk	Positive <i>B. bigemina</i> No.	%	Animals at risk	Positive <i>B. bigemina</i> No.	%
6-12 month	160	3	1.88%	1100	1	0.09%
1-2 year	165	19	11.52%	1200	9	0.75%
2-3 year	165	15	9.09%	1180	6	0.51%
2-4						
>3 year	160	13	8.13%	1160	5	0.43%

Significance variations at: P< 0.01

Table 4: Seoprevalence of *B. bigemina*

Breeding system	No. of surveyed cattle*	Serpositivty for <i>B. bigemina</i>	
		No	%
Small holders	100	47	47%
Intensive system farms	250	9	3.60%
Total	350	56	16.00%

Significance variation at: P< 0.001

*All serosurveyed cattle were over 6 months

It is evident that there is significant age-dependent differences were observed in blood smear positivity for *B. bigemina* in smallholder sector. The age category 1-2 year showed a significant high prevalence (11.52%) in sporadic field cases and small holders. This can be explained by two factors getting-together; age susceptibility

and suitable climatic conditions for tick. Since the calving season in Egypt extend from September to February and natural immunity lasts 9 months (Riek, 1968) so, during the first spring and summer seasons the calves are protected with the natural immunity but during the subsequent spring and summer seasons by the time the

cattle were 16-22 months old, that natural protection against infected ticks was ended and therefore high infection rate can take place.

Tick identification

All ticks identified on investigated cattle in study area were *Boophilus annulatus* according to the keys of Hoogstraal and Kaiser 1956.

Seroprevalence

In this study, it was observed that the prevalence of *B. bigemina* by IFAT were found to be 47/100 (47%) of cattle in sporadic field cases and small holders & 9/250 (3.6%) of cattle in intensive system farms. It is clear that the intensive system sector was recorded a significantly lower seroprevalence of *B. bigemina*.

IFAT increased the detection limit for *B. bigemina* from (7, 69% to (47%). It is possible that the parasites are readily detectable in stained blood films only during the first few weeks of infection and as a consequence, serological diagnosis is the most reliable method of detecting subclinical infections (Mahoney, 1964).

Our results are however differ slightly from that of Abo El-kheir (1989) who reported sero-prevalences 23.50 % in Giza, 28.50 % in Beni Suif, 35.60% in Minia and 40.50 % in Fayoum and Abd-El Gawad (1993) who reported the sero-prevalence 36.17 % in Beni Suif. On the other hand, this prevalence was much higher than that mentioned by El-Ghaysh (1993) who recorded 12.50 % in Cairo and 4.00% in Upper Egypt.

In areas where babesiosis are present, husbandry practices, and tick control strategies has led to the concepts of enzootic stability and instability.

Based on the information gained from a serological study, the immune status of cattle in an area can be classified into an endemically stable (81-100% positive sera) situation, a situation approaching stability (61-80%), an unstable (21-60%) situation,

a minimal disease situation (1-20%), and a disease-free situation (0% positive sera) (Norval, Fivaz, Lawrence & Daillecourt 1983). Where the inoculation rate of *Babesia* is adequate to ensure that all calves are infected while they are protected by innate and/or colostral immunity, clinical disease is minimal and endemic stability is achieved. The disruption of an existing situation of endemic stability is usually associated with drought conditions (De Vos 1979), or increased tick control (Norval et al. 1983). Endemic instability, on the other hand, describes the situation in a herd where some animals fail to become infected within nine months of birth. When such susceptible individuals encounter infected ticks, clinical disease develops (Howell, De Vos, Bezuidenhout, Potgieter & Barrowman 1981).

Endemic situation

Mahoney, (1974) recorded that six to nine months of age is regarded as the practical limit within which calves must receive infection with *Babesia* in order to maintain an endemically stable situation and Radostits, et al., (2007) reported that there is a high infection rate with *B. bigemina* in calves 6-12 months of age. Therefore, the seroprevalence 6-12 age group in our study is suitable as informative of the endemic situation.

Endemic situation in sporadic field cases and small holders sector:

Defining the endemic state on the basis of seroprevalence of the age 6 to 12 month age group implies that in sporadic field cases and small holders sector there was an overall situation of endemic instability for *B. bigemina* with seroprevalences of lower 60% (36%) and it is at high risk of the disease.

Endemic situation in intensive farms:

The prevalence of antibodies to *B. bigemina* in the 6-12 month age group in intensive farms was 8.00%, showing very

Endemic situations and clinical cases estimates

Small holders sector			Intensive farms		
Seroprevalence of 6 - 12 month age group	Endemic situation	Clinical cases percent	Seroprevalence of 6 - 12 month age group	Endemic situation	Clinical cases percent
36.00%	Endemic instability with high risk of the disease	7.69%	8.00%	low risk of the disease (minimal disease situation)	0.45%

low prevalence fewer than 10% suggesting low risk of the disease (a minimal disease situation) because the inoculation rate is insufficient to infect animals in later life.

It was observed that the seroprevalence of 6 - 12 month age group for *B. bigemina* found to be 36.00 % indicative of an endemic instability situation with high risk of the disease that ascertained by observation 7.69% prevalence by blood smear in sporadic field cases and small holders sector. A converse situation is present in intensive farms where the seroprevalence of *B. bigemina* were detected as only 8.00 % indicative of a low risk of the disease due to the very low challenge (minimal disease situation) that ascertained by observation a very low prevalence by microscopic examination (0.45%)

In the sector of sporadic farmers and small holders; the instability situation is consistent with the picture of the current management procedures chiefly tick control practices since most farmers and traditional breeders practice tick control measures in irregular indiscriminate manner. Most of farmers and traditional breeders perform some form of tick control measures some of them gathered more than one practice as ivermectins injection and acaricide treatment. A great proportion of farmers and traditional breeders carried out these practices erratically each one according its own belief. Moreover, there were the Ethnoveterinary methods practiced by some farmers besides the free governmental spraying campaigns (1-2 times) carried out during summer season. The indiscriminate

use of drugs may disrupt the condition of endemic stability to tick borne diseases (Lawrence *et al.*, 1980).

It has been concluded that endemic instability for *B. bigemina* was existed in the study area in Dakahlia province and the cattle population at high risk of the disease in both farmers and small holders. The indiscriminate use for drugs and acaricides may responsible for disruption the condition of endemic stability to tick borne diseases in farmers and small holder sector. In intensive farms sector in Daimetta province the endemic situation for babesiosis was minimal situation. This is of relevance with clinical cases estimates through blood smears positivity.

However, that study did not reflect the epidemiological situation of the intensive cattle population of Dakahlia province for babesiosis due to problems with access or to the unwillingness of the owners of intensive farms to participate in the study therefore; the dairy intensive farms in Dakahlia province need to be investigated.

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EPIDEMIOLOGICAL STUDIES ON BOVINE ANAPLASMOSIS

Salm F F¹, Younis E E², Hegazy N M³ and El-Sawalhy A A⁴

¹Veterinary Teaching hospital Fac. Vet. Med., Mansoura University, Egypt

²Dep. Internal med. and infectious disease Fac. Vet. Med., Mansoura University, Egypt

³Veterinary Serum and Vaccine Research Institute, Abbasia, Egypt

⁴African Union/Interafrican Bureau for Animal Resources (AU-IBAR),

Summary

This study carried out at Dakahilia and Daimetta provinces in Nile Delta, Northern Egypt. For determination, the current existence of bovine anaplasmosis in cattle populations, in Dakahlia province 650 cattle of different ages (all of them were over six months), and 4640 in Daimetta province were investigated. From suspected cases the peripheral blood smears were examined microscopically. For characterization the risk of anaplasmosis, 350 cattle over 24 weeks were sampled for seroepidemiological survey and assessing endemic stability (100 from sporadic field cases and small holders randomly selected and 250 from intensive system farms). The prevalence of *A. marginale* through Giemsa stained blood smears positivity was found to be (6.30 %) in sporadic field cases and small holders > sector and (9.05%) in intensive system sector. Blood smears positivity cleared a seasonal pattern and an age profile with significant differences. In sporadic farmers and small holders sector at Dakahlia province; seroprevalence by IFAT for *A. marginale* was found to be (42%) in sporadic field cases and small holders sector & (61.2%) in intensive system sector, indicative of a situation of endemic instability with significant clinical disease risk in both sectors. In investigated intensive farms in Daimetta province some anaplasmosis outbreaks happened in absence of tick-vector that may indicate that stress and mechanical transmission are key factors in the expression of the disease within infected herds.

Key words: Prevalence, ANAPLASMOSIS, Giemsa, peripheral blood smears, Egypt

ETUDES EPIDEMIOLOGIQUES SUR L'ANAPLASMOSE BOVINE

Résumé

La présente étude a été réalisée dans les provinces de Dakahilia et de Damiette de la région du Delta du Nil, au Nord de l'Egypte. La finalité de ces travaux de recherche était de constater l'existence réelle de l'anaplasrose bovine dans le cheptel de la région. Les travaux de recherche ont porté sur 650 bovins de la province de Dakahlia d'âges différents, mais supérieurs, pour l'ensemble d'entre eux, à 6 mois et sur 4 640 bovins de la province de Damiette. Les frottis de sang périphériques des animaux considérés comme suspects ont été analysés au microscope. Pour circonscrire de manière effective le risque d'anaplasrose, 350 animaux ont été sélectionnés pendant plus de 24 semaines en vue d'une enquête séro-épidémiologique et d'une évaluation de la stabilité endémique (100 têtes ont été triées de manière aléatoire dans les élevages sporadiques et les petits exploitants agricoles, contre 250 têtes dans les systèmes d'élevage intensif). La méthode de coloration panoptique de frottis sanguin de Giemsa a permis de détecter et d'identifier, dans le secteur des éleveurs sporadiques et des petits exploitants agricoles un taux de prévalence d'Anaplasmosis marginale de 6,30% contre 9,05% dans le secteur d'élevage intensif. La réaction positive des frottis sanguins a permis de mettre en lumière le caractère saisonnier de l'épidémie d'anaplasrose bovine et un profil d'âge présentant des différences notoires entre les bovins. Dans le secteur des éleveurs sporadiques et des petits exploitants agricoles de la province de Dakahlia, la séroprévalence à Anaplasmosis marginale estimée, selon la méthode sérologique de l'immunofluorescence indirecte (IFAT), à 42%,

contre 61,2% dans les systèmes d'élevage intensif a permis de se rendre compte de la situation d'instabilité endémique accouplée au risque élevé de maladies cliniques qui prévaut en définitive dans les deux secteurs. Dans les systèmes d'élevage intensif de la province de Damiette où a été réalisée l'enquête, l'on a noté la présence de certains foyers d'anaplasmose en l'absence des tiques qui en sont les agents pathogènes, ce qui pourrait indiquer que la pression spatiale et la transmission mécanique constituent les principaux facteurs de l'expression de la maladie dans les troupeaux infectés.

Mots clés: Prevalence, Anaplasmose Giemsa, coloration panoptique, Egypte

Introduction

Tick-borne diseases «TBDs» occurring in Egypt are assuming more importance as they continue to be a major constraint on cattle population, especially in the high yielding breeds of exotic cattle in intensive system production.

Latif (1994) denoted that despite considerable progress made in combating ticks and tick-borne diseases, the latter seem to be increasing both in prevalence and in severity. Tick-borne diseases are responsible for hundreds of millions US dollar losses per year in tropical and temperate areas where they pose a problem.

Anaplasmosis, caused by the rickettsial hemoparasite, *Anaplasma marginale*, is one of the most prevalent tick-transmitted diseases of cattle and selected ruminants worldwide. Tick transmitted diseases such as babesiosis, theileriosis and anaplasmosis are economically important globally Uilenberg, (1995); Dumler et al., (2001); Kocan et al., (2003)

A. marginale is transmitted mainly by the one-host tick *B. microplus* but it may also be transmitted by other *hematophagous arthropods* such as Tabannids. Callow, (1984); Alonso et al., (1992); Nari, (1995) and Guglielmo, (1995)

Attempts to improve native breeds through the importation of highly producing dairy cattle have often resulted in high mortality from tick born diseases (TBDs) (Loria et al., 1999)

The principle of endemic stability to TBDs was first mooted by Mahoney & Ross (1972) in Australia, using *Babesia bovis* in *Boophilus microplus* as an example. They

stated that if the inoculation rate of the protozoa by the tick into cattle is sufficiently high, then all calves would be infected whilst still protected by age resistance. Clinical disease would be minimal and endemic stability would be achieved. If, however, the inoculation rate is not sufficiently high, calves would not be immunized before they lose their age resistance and clinical cases would result. With low tick numbers disease transmission is interrupted, resulting in minimal disease.

Anon. (1984) recommends that, in general terms, the model developed by Mahoney and Ross (1972) can be extended to other tick-borne diseases in similar studies.

Gitau et al., (1997) suggested that the seroprevalence of tick-born pathogens in Kenyan smallholder dairy cattle may be informative of the endemic state of a state tick-borne pathogens and permit identification of management methods and geographic regions where the development of a state of «endemic stability» may be feasible.

In Egypt where ticks and tick-borne diseases currently exist and there is consensus on the significant economic impact of these diseases, epidemiological studies are fundamental as a basis for tick management plan. The epidemiological data of such diseases in Egypt has not been described enough to compile information on the local epidemiological patterns and its relation to endemic stability or instability. The clinical importance of bovine anaplasmosis had been negligible in Egypt. In the study area; it had been reported once in a cattle herd in Daimetta province (Younis

Table 1: Distribution of examined cattle and study area

Farm	Farm I	Farm II	Farm III	Farm IV
Cattle No.	1200	2800	1400	400
Cattle crossbreeds	Friesian/ Holstein/ Simental	Friesian/ Holstein	Friesian/ Holstein/ Swiss Brown	Friesian/ Holstein
Hygiene measures	Moderate	Bad	Good	Bad
Overcrowding	Not overcrowded	Overcrowded	Not overcrowded	Not overcrowded
Fencing	Fenced	Not Fenced	Fenced	Fenced
Uncovered drainage channels problem	Not present	A lot present around the	Not present	Not present
Problem	Farm			
Herd additions practices	Discriminate	Indiscriminate	Discriminate	Discriminate
Tick control practices	(Butox®) 2 weeks interval in hot weather and 8 weeks in cold weather			
Hematophagous arthropods control	Snip® for flies control	Diesel mixed with Butox® spraying morning and evening		

et al., 2007).

Therefore we are interested in studying the risk factors that affect on the occurrence of bovine anaplasmosis, determination the prevalence of bovine anaplasmosis and assesment of the endemic status of bovine anaplasmosis with regard to its effect on the clinical reaction.

Materials and Methods

Cattle and study area:

The study was conducted between June 2005 and June 2007 on cattle at Dakahlia and Daimetta provinces in Nile Delta, Northern Egypt.

In Daimetta province, all investigated cattle were foreign breeds; these cattle were kept under an intensive managerial system. Four farms were selected for the study basing on their history of problems related to anaplasmosis diagnosed by detection of *Anaplasma marginale* in Giemsa-stained blood smears. *Anaplasmosis* epidemics were observed in two farms. Our study tried to describe and investigate epidemics of *anaplasmosis* in these two farms (Farms I and II). As well as investigation of

clinical anaplasmosis cases in another two herds (farms III and IV).

In Dakahlia province, the available investigated cattle reared under the traditional management systems were collected from different sources;

1. Cattle reared by smallholders in different regions (Mansoura, El-Senbellawin, Dikrnis and Bilkas).
2. Cases admitted to the clinic of Educational Veterinary Hospital, Mansoura University, located in Shoha Village about 8 km North East of Mansoura. The majority of cattle in the area are of mixed-breed origin.

For determination, the current existence of bovine anaplasmosis in cattle populations in the study area, in Dakahlia province 650 cattle of different ages (all of them were over six months) were examined according to (Kelly 1994), 416 of them were apparently healthy and 234 of them were suspected cases. In Daimetta province 4640 cattle were investigated, 976 of them were suspected. From suspected cases the peripheral blood smears were examined microscopically. We considered feverish animals (temperature over 40°C) infested

with ticks or not and cattle infested with tick feverish or not as suspected cases. Ticks on these animals that may be implicated as vectors were collected for identification.

For characterization of the risk of anaplasmosis in the study area, we sampled 350 cattle all of them over 24 weeks for seroepidemiological survey and assessing endemic stability (100 from sporadic field cases and small holders randomly selected and 250 from intensive system farms). Sampled cattle were selected to represent different locations and production systems currently existed.

Managemental characteristics:

For collecting wider farm data managemental characteristics for different production systems for analysis of seropositivity and its relation to endemic stability or instability; we designed a questionnaire, which was administered on visited farms, smallholders and household cattle owners. The questionnaire was designed to include mostly closed ended questions to ease data processing, minimize variation and improve precision of responses in accordance with (Thrusfield 2000).

Management system was categorized into three groups according to the flock size (F.S) and the nature of management: Farmers (F.S 1-5 Heads), Traditional Breeders (5 < F.S < 100 Head) and Intensive System (F.S > 100 Head). Most of the cattle kept in the study area for farmers and small holders are mixed crosses whereas in intensive farms, most of the cattle kept are of high-performance as Friesian, Holstein, Swiss Brown, and Simmental. Native cattle represent a very few proportion of cattle stocked by farmers.

Most farmers and traditional breeders practice tick control measures in irregular indiscriminate manner for tick control. Some use acaricide treatment. Butox[®] or Diazinon[®] through hand washing or spraying, some use ivermectin injection, and others use ethnoveterinary methods as removal ticks by hand and using ghee or engine oil as an acaricide. Some farmers

use more than one measure at the same time and others didn't practice any form of tick control practices. In addition there were governmental spraying campaigns (1-2 times) during summer season. On the other hand, the tick control programmes were more aggressive in intensive farming. The owners of investigated four farms were controlled ticks using the acaricide belonging to the group of Deltamethrin (12.5 mg) (Butox[®]) by spraying at different frequencies ranging from 2 weeks interval in summer and 8 weeks in winter season. The program had been sustained with good results.

Samples:

Blood smears from 234 cattle in Dakahlia province and 976 in Daimetta province were taken from capillary venous blood of the tip of ear. Blood was collected aseptically from (350 cattle) from the jugular or coccygeal veins in sterile serology tubes using 20-gauge needles without anticoagulant for serology testing purpose. Serum samples were stored at -2^oC until used. Tick samples from suspected cattle were taken for tick identification.

Examination of blood films:

The blood smears examined about ¼ or ½ inch from the end of the film and transversed from one side of the films of the other (cross-sectional-method) to give a constant and representative sample according to (Barrent, 1965).

IFAT:

IFAT was done for estimation of antibodies titers on collected sera according to Akinboade and Dipelu (1984) and Hegazy *et al.*, (2003).

Tick collection and identification:

Each suspected animal was carefully checked for ticks and tick specimens were placed into 70% ethanol in a single glass vial for an individual animal. Ticks were identified according to the keys of Hoogstraal and

Table 2: Prevalence of bovine anaplasmosis based on blood film related to the area and production system.

Breeding system	Locality	Animals at risk	Positive blood smear for <i>A. marginale</i>	
Sporadic field cases and small holders*	E.V.H.C#	208	15	7.21%
	El-Mansoura	211	12	5.69%
	Dikrnis	90	6	6.67%
	El-Senbellawin	92	4	4.35%
	Bilkas	49	4	8.16%
	Total	650	41	6.31%
Intensive system farms**	Ras elbar	960	130	13.54%
	Daimetta	3680	290	7.88%
Total		4640	420	9.05%

Educational Veterinary Hospital Clinic, Mansoura University

There a significance variation at $P < 0.05$ between sporadic field cases and small holders sector and intensive system farms sector

Table 3: Seasonal dynamics of blood smear positivity for *A. marginale*:

Season	Small holders		intensive system farms			
	Animals at risk	Positive <i>A. marginale</i>		Animals at risk	Positive <i>A. marginale</i>	
		No.	%		No.	%
Summer	165	20	12.12%	1200	144	12.00%
Autumn	160	8	5.00%	1130	38	3.36%
Winter	160	4	2.50%	1160	134	11.55%
Spring	165	9	5.45%	1150	104	9.04%

Significance variation at: $P < 0.001$

Kaiser (1956).

Results and Discussion

Parasitological findings

A. marginale were diagnosed as their typical spherical granules 0.2 to 0.5 microns in diameter located near the periphery of the red blood cells.

Epidemiological findings

Prevalence of anaplasmosis based on blood film

In Dakahlia province, out of 650 investigated cattle 234 of them were suspected from which 41 animals (6, 31%) were infected with *A. marginale*. In Daimetta province, out of 4640 investigated cattle 976 of them were suspected from which 420 animals (9.05%) were infected with *A. marginale*.

A. marginale studies reported in Egypt was lacking. In this study, it was

observed that the prevalence of *A. marginale* by stained blood smears was found to be 6.30% of cattle in sporadic field cases and small holders' sector and 9.05% in intensive system sector. These prevalences which are comparable to that of *B. bigemina* raised the question whether the pathogen's presence in Egypt had been underestimated. This prevalence is higher than that mentioned by Younis *et al.*, (2009) who reported a prevalence of (3.5%) and much higher than that mentioned by El-Metenawy (1999) in Saudi Arabia who reported a prevalence of (0.98%).

Stained blood smears positivity cleared that there is significant season-dependent differences were observed as the highest prevalence for *A. marginale* was in summer (12.12%) followed in spring (5.45%) then in autumn (5.00%) and with the minimum prevalence (2.5%) in winter, in a pattern similar to that reported previously by many Egyptian workers as Ahmed (1980)

Table 4: Effect of age on the prevalence of *A. marginale*

Season	Small holders		intensive system farms			
	Animals at risk	Positive <i>A. marginale</i>		Animals at risk	Positive <i>A. marginale</i>	
		No.	%		No.	%
6-12 month	160	2	1.25%	1100	35	3.18%
1-2 year	165	17	10.30%	1200	141	11.75%
2-3 year	165	13	7.88%	1180	129	10.93%
>3 year	160	9	5.63%	1160	115	9.91%

Significance variations at: P < 0.01
P < 0.001

Table 5: seroprevalence anaplasma marginale by IFAT

Breeding system	No. of surveyed cattle*	Serpositivity for <i>A. marginale</i>	
		No.	%
Small holders	100	42	42%
Intensive system farms	250	152	61.20%
Total	350	194	55.43%

Significance variation at: P < 0.01

*All serosurveyed cattle were over 6 months

and Sakla, (1995) for *B. bigemina*. This pattern is consistent with the climate of the study area where summer is the hottest season followed by spring whereas autumn is the mildest season and winter is the coldest one. In intensive farms, there was a different pattern with a significant statistical difference as the prevalence in winter season (11.55%) was higher than that in spring (9.04%) and autumn (3.36%) seasons. FMD outbreak that hit the study area from January to March 2006 can explain this clinical difference as anaplasmosis may express itself in intensive farms under effect of concurrent infections and other stresses.

With respect to age categories, it is evident that there is significant age-dependent differences were observed in blood smear positivity in smallholder sector and in intensive system. The age category 1-2 year showed a significant high prevalence (10.30%) respectively in sporadic field cases and small holders & (11.75%) in intensive farms. This can be explained by two factors getting-together; age susceptibility and suitable climatic conditions for tick. Since the calving season in Egypt extend from September to February and natural immunity

lasts 9 months (Riek, 1968) so, during the first spring and summer seasons the calves are protected with the natural immunity but during the subsequent spring and summer seasons by the time the cattle were 16-22 months old, that natural protection against infected ticks was ended and therefore high infection rate can take place.

Tick identification

All ticks identified on investigated cattle in study area were *Boophilus annulatus* according to the keys of Hoogstraal and Kaiser 1956.

Seroprevalence

In this study, it was observed that the prevalence of *A. marginale* by IFAT was found to be and (42%) of cattle in sporadic field cases and small holders sector & (61.2%) of cattle in intensive system sector. It is clear that the intensive system sector was recorded a significantly higher seroprevalence of *A. marginale* than that recorded in smallholder sector.

In this study, it was observed that the sero-prevalence of *A. marginale* was found to be 42.00 % of cattle. This sero-prevalence

which is comparable to that of *B. bigemina* established the pathogen's underestimation in Egypt. *A. marginale* studies reported in Egypt was missing. Out of the country, our sero-prevalence is in agreement with José de la Fuente *et al.*, (2005) who reported a sero-prevalence 50% in Sicily, Italy. On the other hand, this prevalence is contradictory to findings of other workers; Dreyer, *et al.*, (1998) Maloo *et al.*, (2001), Mtshali *et al.*, (2004), and Mike *et al.*, (2005) whom reported the following prevalences 98.60% in South Africa, over 80% in Kenya, 87% in South Africa., and 87.5% in Guatemala respectively.

IFAT increased the detection limit for *A. marginale* from (6, 3%) to (42%). It is possible that the parasites are readily detectable in stained blood films only during the first few weeks of infection and as a consequence, serological diagnosis is the most reliable method of detecting subclinical infections (Mahoney. 1964).

In areas where babesiosis are present, husbandry practices, and tick control strategies has led to the concepts of enzootic stability and instability.

Based on the information gained from a serological study, the immune status of cattle in an area can be classified into an endemically stable (81-100% positive sera) situation, a situation approaching stability (61-80%), an unstable (21-60%) situation, a minimal disease situation (1-20%), and a disease-free situation (0% positive sera) (Norval *et al.*, 1983). Where the inoculation rate of *Babesia* is adequate to ensure that all calves are infected while they are protected by innate and/or colostral immunity, clinical

disease is minimal and endemic stability is achieved. The disruption of an existing situation of endemic stability is usually associated with drought conditions (De Vos 1979), or increased tick control (Norval *et al.*, 1983). Endemic instability, on the other hand, describes the situation in a herd where some animals fail to become infected within nine months of birth. When such susceptible individuals encounter infected ticks, clinical disease develops (Howell, *et al.* 1981).

Mahoney, (1974) recorded that six to nine months of age is regarded as the practical limit within which calves must receive infection with *Babesia* in order to maintain an endemically stable situation and Radostits, *et al.*, (2007) reported that there is a high infection rate with *B. bigemina* in calves 6-12 months of age. Therefore, the seroprevalence 6-12 age group in our study is suitable as informative of the endemic situation. Guglielmone, (1995) denoted that anaplasmosis shares some epidemiological features with babesiosis: primary infection in calves is less likely to result in clinical disease and a long lasting immunity develops. Therefore, the concepts of endemic stability are used for babesiosis may also be applied to anaplasmosis

Endemic situations:

Defining the endemic state on the basis of seroprevalence of the age 6 to 12 month age group implies that there was an overall situation of endemic instability with seroprevalences of lower 60% (32% and 53.97%) in sporadic field cases and small holders sector and intensive farms sector

Table 6: Endemic situations and clinical cases estimates

Small holders sector			Intensive farms sector		
Seroprevalence of 6 - 12 month age group	Endemic situation	Clinical cases percent	Seroprevalence of 6 - 12 month age group	Endemic situation	Clinical cases percent
32.00%	Endemic instability with high risk of the disease	6.31%	53.97%	Endemic instability with high risk of the disease	9.05%

Table 7: Comparison of the total clinical anaplasmosis cases between the investigated four farms:

Farm	Animals at risk	Diseased cattle with anaplasmosis			Total	
		FMD	BEF	LSD	No.	%
Farm I	960	125	3	2	130	13.54%
Farm II	2240	160	95	29	284	12.68%
Farm III	1120	2	2	1	5	0.45%
Farm VI	320	—	1	—	1	0.31%
Total	4640	287	101	32	420	9.05%

respectively and both sectors are at high risk of *A. marginale*.

It was observed that the seroprevalence of 6 - 12 month age group for *A. marginale* found to be 32.00 % for sporadic field cases and small holders sector and 53.97% for intensive farms sector so as to indicate of an endemic instability situation with high risk of the disease that ascertained by observation 6.31% and 9.05% prevalence by blood smear in small holders sector and intensive farms sector respectively.

Anaplasmosis epidemics observation and investigations in intensive farms:

Diagnosis of clinical anaplasmosis within the investigated farms was based on clinical signs that appeared as; fever, anorexia, severe anemia, icterus, abortions, weakness, weight loss, and death and post-mortem lesions observed as; anemic and jaundiced carcasses, thin and watery blood and characteristically enlarged spleen and laboratory confirmation through demonstration of inclusions bodies of *A. marginale* that appeared as; spherical granules inside red blood cells near the periphery.

Clinical disease and epidemics of anaplasmosis were occurred during or subsequent to other outbreaks of FMD, BEF and LSD that hit the study area one after the other from January to October 2006 in investigated farms that sustained an efficient regular tick control program leads to absence of ticks. The four farms practiced some sort of hematophagous arthropods control practices of doubtful efficacy. During the initial investigation it

was found that injections for treatment purposes and blood sampling of cattle with shared needle were a common procedure on these farms.

It was known that clinically recovered animals remain carriers with a non-detectable parasitemia and thus act as a reservoir of the disease. Thus, carrier animals serve as reservoirs of infection for mechanical transmission and infection of ticks (Reevas and Swift, 1977; Eriks *et al.*, 1989; Futse *et al.*, 2003). All cattle kept in the four investigated farms were exotic breeds, Friesian, Holstein and Simental. Exotic breeds, especially those originating from temperate climates and, in particular, purebreds of high-performance milking cows, are known to be very susceptible to anaplasmosis and babesiosis (Riek, 1968; Ristic, 1968).

As the investigated farms practiced an efficient regular tick control measures and tick vectors did not occur and there was some sort of hematophagous arthropods control program with suspicious efficacy, consideration of these epidemiological investigation information's suggests that mechanical transmission can be the major route of infection from carriers within these herds or recent introduced infected animals to the susceptible animals. It is reasonable, therefore, that reused needles and biting insects may be major transmitters of anaplasmosis in these farms. This is consistent with *A. marginale* being transmitted both mechanically by biting flies or blood-contaminated fomites and biologically by ticks.

The infection would normally be

expected to be self-limiting in the absence of tick vectors, but as epidemics were occurs though tick vector absence, they are expected to be due to stress. The investigated herds suffered many stresses as pregnancy, infectious diseases stresses that decrease the herd's immunity and the unusual amount of injections during treatment tryouts during the primary outbreaks with shared needles. It appears that all these stress factors may led to expression of the disease in infected cattle that appears to have spread relatively easily within the herds in this case. Stress resulting from concurrent infections has been reported to cause patent parasitaemia and clinical anaplasmosis to emerge in premune carrier animals as well as other diseases (Fox *et al.*, 1993).

Emerging of clinical anaplasmosis infections in cattle suffering from disease stress in harmful affected herds (farms I, II) probably exacerbated the poor health condition of the affected cattle, either through anaemia caused by anaplasmosis or through synergistic effects due to interaction among various combinations of these diseases resulting in more deterioration and more losses.

It was observed that clinical anaplasmosis was displayed with varying degrees of intensity reflecting the great variation in severity of anaplasmosis epidemics according to the primary outbreak that associated with it and management practices at the level of individual farms.

With regards to the outcome of anaplasmosis epidemics at the level of individual farms, the situation varied from no or some clinical cases (Farms VI, III herds in which the management is better overall) to an epidemic of the disease that caused significant mortality of cattle (Farms I, II herds in which the management is worse overall). However we can declare it is likely that farms subjected to unusual amount of stresses, with low levels of hygiene, which followed discriminate herd additions practices were the most affected and had highest mortality risks.

Four main factors may have precipitated these anaplasmosis epidemics. The first, breed susceptibility to *Anaplasma marginale*, the second, presence of carrier animals, the third, enhanced mechanical transmissions, and the fourth, disease and pregnancy stresses.

There is a group of implications for our study:

1. Endemic instability for anaplasmosis was existed in Dakahlia province in small holders sector and in Daimetta province in intensive farms sector and the cattle population at high risk of the disease. This is of relevance with clinical cases estimates through blood smears positivity. Furthermore, anaplasmosis epidemics in investigated farms are also a reminder of the instability situation for *A. marginale* in intensive farms sector.
2. There were indiscriminate use for drugs and acaricides in farmers and small holder sector in Dakahlia province that may disrupt the condition of endemic stability to the disease.
3. Anaplasmosis outbreaks in absence of tick-vector may indicate that stress is a key factor in the expression of symptoms and mechanical transmission can be the major route of infection spread within infected herds.
4. Recognition and treatment of concurrent infections, as well as minimizing managerial stresses, are essential in the successful management of anaplasmosis in cattle herds' especially exotic purebreds of high-performance milking cows.
5. At the present time, anaplasmosis seem to be increasing in economic impact in Daimetta province, where they now pose a problem for dairy intensive farms.
6. However, that study did not reflect the epidemiological situation of the intensive cattle population of Dakahlia province for the disease due to problems with access or to the unwillingness of the owners to participate in the

study therefore; the dairy intensive farms in Dakahlia province need to be investigated.

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PREVALENCE OF ENZOOTIC BOVINE LEUKOSIS (EBL) IN THE NORTHERN SOMALIA

Yasser M Ghanem^{1,3*}, Mohamed S Ahmed² and Ahemd H. Abdelkader³

¹Department of Animal Medicine (Infectious Diseases), Faculty of Veterinary Medicine, Kafrelsheikh University, Kafrelsheikh 33516, Egypt.

²Department of Pathology, Faculty of Veterinary Medicine, Kafrelsheikh University, Kafrelsheikh 33516, Egypt.

³Laboratory of the Gulf Veterinary International Quarantine Management Company, Berbera, Somaliland, Somalia.

Abstract

In the present study, a commercial immuno enzymatic assay (blocking-ELISA), were used to detect BLV antibodies in bovine serum using two monoclonal antibodies against the viral gp51 from bovines of two major districts namely, Waqoyi Galbed, and Togdheer of northern Somalia (Somaliland). Out of 468 tested cows collected from 20 herds, 1.5 % was found affected by Enzootic Bovine Leucosis (EBL) reacted positively to blocking-ELISA. On herd level, out of 20 herds tested, 6 (30.0%) were seropositive. On animal level, according to age groups tested, out of 91 tested sera aged from 2y-5y, 2.2% (n=2) animals were seropositive, while out of 259 bovine sera tested aged from 5y-8y, 1.7% (n=5) animals were seropositive. Prevalence on district level, in Waqoyi Galbed, out of 204 tested cows from 9 herds, 1.47% (n=3) animals were found seroreactive, and on herd level, out of 9 herds tested, 2 herds (22.2%) were seropositive and 7 (77.8%) were seronegative. In Togdheer, out of 264 tested cows from 11 tested herds, 4 (1.52%) animals were found seropositive, and on herd level out of the 11 herds tested 4 herds (36.4%) were seropositive and 7 (63.6%) were seronegative. This paper reports the first serological evidence of EBL virus infection in dairy cows in the Somaliland investigated regions.

Keywords: Enzootic bovine leukosis, Prevalence, Somaliland, ELISA

PRÉVALENCE DE LA LEUCOSE BOVINE ENZOOTIQUE (LBE) DANS LE NORD DE LA SOMALIE

Résumé

Dans la présente étude, un dosage immuno-enzymatique d'ELISA bloquant facilement disponible dans le commerce a été utilisé pour détecter les anticorps de du virus de la leucose bovine enzootique dans le sérum bovin à l'aide de deux anticorps monoclonaux contre la glycoprotéine virale gp51 chez les bovins des deux importants districts de Wagoyi Galbed et de Togdheer du Somaliland (Nord de la Somalie). Sur les 468 bovins soumis au test de leucémie bovine sélectionnés au sein de 20 troupeaux, 1,5% des animaux affectés par la leucose bovine enzootique (LBE) ont réagi positivement aux épreuves ELISA de blocage. Au niveau des troupeaux, sur les 20 troupeaux testés, 6 troupeaux (soit 30% de l'ensemble) ont été trouvés séropositifs. Au niveau des animaux, sur la base des groupes d'âge testés, sur 91 bovins âgés entre 2 ans et 5 ans soumis aux tests du sérum, 2,2% (soit 2 animaux) ont été reconnus positifs, alors que sur 259 bovins âgés entre 5 ans et 8 ans soumis aux tests du sérum, 1,7% (soit 5 animaux) ont été reconnus séropositifs. S'agissant par ailleurs de la prévalence au niveau des districts, notamment dans le district de Wagoyi Galbed, sur les 204 bovins soumis aux tests du sérum issus de 9 troupeaux, 1,47% (soit 3 animaux) ont été reconnus séroréactifs à l'antigène bloquant ELISA. Et au niveau des troupeaux, sur 9 troupeaux soumis au test du sérum, 2 troupeaux (soit 22,2%) ont été reconnus

*Corresponding Author: yaamyds7@yahoo.com

séropositifs et 7 troupeaux (63,6%) ont été trouvés séronégatifs. Dans le district de Togdheer, sur les 264 bovins soumis aux tests du sérum issus de 11 troupeaux soumis aux tests du sérum, 4 animaux (soit 1,52%) ont été trouvés séropositifs, et au niveau des troupeaux, sur les 11 troupeaux soumis aux tests du sérum, 4 troupeaux (soit 36,4%) ont été reconnus séropositifs et 7 troupeaux (63,6%) ont été reconnus séronégatifs. Le présent rapport est le tout premier document du genre à apporter la preuve concrète, fondée sur les données sérologiques, de l'infection, par le virus de la leucose bovine, des vaches laitières de la région du Somaliland ayant servi de cadre d'étude.

Mots clés: Leucose bovine enzootique, Prévalence, Somaliland, ELISA

Introduction

Bovine leukemia virus infection is a blood borne disease, which may be transmitted both vertically and horizontally; however, horizontal transmission is considered to be more important (Martin, et al., 2001). Cattle are the natural hosts for BLV, but the disease is more prevalent in milk bovine than beef (D'Angelino, et al., 1998), Hopkins and Di Giacomo, 1997). Once infection has occurred, 80% to 90% of animals become *BLV-seropositive*. Of these infected cattle, 30% will develop persistent lymphocytosis, 5% develop lymphomas and about 50% have a *lymphoblastic leukaemia* (Kaczmarczyk et al., 2005), George, 2007). Infected cattle may have an *asymptomatic* course, and become carrier (Trono et al., 2001). However, clinical disease may be characterized by seroconversion but without any clinical signs, persistent *B cell lymphocytosis*, and the development of solid lymphoid tumors (Kabeya et al., 2001).

The importance of BLV is based on the economic losses primarily due to condemnation of cattle with leukosis, reduction of milk production and a shorter life span among high yielding dairy cows, and loss of trade opportunities with countries restricting the importation of BLV-infected cattle. Globally, EBL infection may also place severe restrictions on the import and export of cattle and semen (Motton and Buehring, 2003).

The number of BLV infections in European Union countries, and other world regions (North America, Africa, Australia) was high (Schwartz and Levy, 1994). As a result of adequate financial support and the

strict performance of eradication programs, after 10 to 15 years the disease disappeared completely in most EC countries (Belgium, The Netherlands, Denmark, Germany, France, Great Britain, Austria, Finland (Knapen et al., 1993), (Nuotio, et al., 2003).; however, some countries only sporadic cases were encountered (Polet, 2004) and other countries recorded a high seroprevalence (Uysal, et al., 1998), (Nasir, 2005), (Teresa et al., 2007). Animal trading was recorded to transmit the infection to the dairy cattle farms (Zaghawa et al., 2002).

The UN Development Program (UNDP) and the UN Food and Agricultural Organization (FAO) commended the formation of a Somali Livestock Board that could help the industry to meet the requirements of importing countries of disease-free livestock and meat products originating from Somalia. The total cattle population (unofficial records) estimated is nearly 4.000.000 -5.000.000 millions head.

BLV diagnosis are based on the application of tests such as immunodiffusion (ID), enzyme linked immunosorbent assay (ELISA) as Different ELISAs have been used in eradication programs and there are several commercial kits available to detect antibodies against the principal viral proteins (gp51 and p24) where, in early periods after infection and in animals with persistent lymphocytes a high titer of antibodies against p24 (a core protein) is observed. Antibodies to gp51, however, were detected with higher titers than antibodies to p24 protein, western blot (WB) and polymerase chain reaction (PCR) (Beier et al., 1998), (Blankenstein et al., 1998), (Dolz and Moreno, 1999), (Fechner et al., 1997), (Gardner and Greiner,

1999), (González *et al.*, 1999), (González *et al.*, 1999), (González *et al.*, 2001), (Juliarena *et al.*, 2007), (Kozaczyńska, 1999), (Simard *et al.*, 2000), (Reichel *et al.*, 1998).

The ID was considered as the «gold standard» test, which used alone or in combination of methods that unequivocally identifies the virus carrier animal (Riegelman and Hirsch, 1992). The ELISA provides a quantitative result and has the advantage of being more sensitive and less time-consuming than the conventional immunodiffusion technique (Nguyen and Maes, 1993); however, the opinions of different authors are not unequivocal (Kozaczyńska and Kuźmak, 2000), (Fechner *et al.*, 1996).

The ELISAs are now the preferred serological test for detecting antibodies to BLV where both serum and milk samples can be tested by ELISA (OIE, 2004). The blocking ELISA proved to be suitable for detection of antibodies against BLV in serum and milk (Have and Hoff-Jørgensen, 1991).

Information on bovine diseases in Somaliland is sparse, unsystematic and lacking epidemiological investigations elucidating and explaining disease patterns according to prevalent husbandry systems. The goal of this work was to use blocking-ELISA to perform a regional representative report about the prevalence of EBL in field sera samples by detection of BLV antibodies in apparently healthy dairy cows in Somaliland.

Material and methods

Study Area

The present study was conducted during the period from August 2008 to March 2009 at the northern part of Somalia (Somaliland). Two main districts were covered in this study namely, Waqoyi Galbed (Hargiesa), and Togdheer (Burao) which constitute a major area of Somaliland.

Study Animal

A total of 468 blood sera samples

were taken from cows with more than 7 months of age of the native Somali breed originated from two districts of Somaliland (Waqoyi Galbed and Togdheer) at the northern Somalia and involved 20 herd flocks (9 and 11) from Waqoyi Galbed and Togdheer respectively. Information of each cattle sampled were obtained including, its location, herd size, age, health status, whether reared individually, with other species or in a cattle herd. Bovine sera were collected from the two previous mentioned districts as 204 bovine male and female sera from Waqoyi Galbed (37 aged from 7 months-1 year, 38 aged from 2y-5y, and 139 aged from 5y-8y) and 264 bovine male and female sera from Togdheer (45 aged from 7 months-1 year, 53 aged from 2y-5y, and 156 aged from 5y-8y).

Sample collection

468 blood samples were collected randomly from cows in 20 herds. 100% of the total bovine number of examined herds over 7 months of age was sampled. A 10 ml blood samples were collected from peripheral blood aseptically obtained via jugular puncture, using vacutainer tubes with a separate needle for each sample, allowed to clot, and transferred on ice to the laboratory of the Gulf International Veterinary Quarantine at Berbera city of Somaliland. The sera were separated by centrifugation at 2000rpm for 10 min and aspirated in an eppendorf tubes using Pasteur Pipettes, identified and stored at -20°C until testing

Blocking-ELISA

Enzyme linked immunosorbent assay (blocking-ELISA) was used to detect antibodies to BLV, according to the manufacturer's recommendations. INGENASA (INMUNOLOGIA Y GENETICA APLICADA, S.A. (INGEZIM BLV COMPAC 2.0, 1.2.BLV.K.3. (Lot/Batch NO. I30607). This Kit is based on the use of two monoclonal antibodies against the viral gp51. For results interpretation, all samples

Table 1: Overall seroprevalence results of Bovine leucosis virus in Somaliland in different age groups using blocking-ELISA

District	Herd (n = 20)	Cows (n = 468)	7 month-1 year	2-5 years	5-8 years	Positive	Negative
Waqoyi Galbed	9	204	37	38	139	3	201
Togdheer	11	264	45	53	156	4	260
Total	20	468	82	91	295	7	461

Table 2: Overall seroprevalence of BLV in the two studied districts according to different age groups by Blocking-ELISA

Age	Tested cows	All districts Blocking- ELISA		Waqoyi Galbed		Togdheer	
		Positive	Negative	Positive	Negative	Positive	Negative
7month- 1 year	82	0	0	0	37	0	
2-5 years	91	2	89	1	37	1	52
5-8 years	259	5	254	2	137	3	153

Table 3: Seroprevalence of BLV in the two studied districts on herd level

District	Herd No	Total cows	7 months-1- year	2-5y	5y-8y	Positive	Negative
Waqoyi Galbed	1	23	4	5	14	0	23
	2	22	4	5	13	0	22
	3	25	6	5	14	2	23
	4	20	3	4	13	0	20
	5	24	5	3	16	0	24
	6	24	4	4	16	0	24
	7	23	5	3	15	0	23
	8	21	4	4	13	0	21
	9	22	2	5	15	1	21
Togdheer	1	26	4	7	15	0	26
	2	28	6	6	16	0	28
	3	20	3	4	13	0	20
	4	22	4	3	15	1	21
	5	24	4	6	14	0	24
	6	23	2	7	14	1	22
	7	25	5	4	16	0	25
	8	24	5	3	16	1	23
	9	26	5	7	14	0	26
	10	24	4	4	16	0	24
	11	22	3	2	17	1	21

with OD higher than negative cut off value must be considered as negatives. All samples with OD values lower than positive cut off values will be considered as Positives. Samples with OD values between both

cutoffs must be considered as doubtful. For these samples a new assay is recommended after 3 weeks.

Results

The overall seroprevalence of EBL is relatively low where, out of 468 tested cows collected from 20 herds, 1.5 % (n=7) were found affected by EBL reacted positively to blocking-ELISA (Table 1). On herd level, (Table 2 and 3) out of 20 herds tested, 6 (30.0%) were seropositive and 14 (70.0%) were seronegative. On animal level according to age groups tested, out of 82 tested bovine sera aged from 7 months- 1 year, none of them were seropositive (0.0%), and out of 91 tested sera aged from 2-5 years, 2 (2.2%) animals were seropositive, while out of 295 bovine sera tested, 5 (1.7%) animals were seropositive. Prevalence on district level, in Waqoyi Galbed, according to the district of the animals tested, out of 204 tested cows from 9 herds, 3 animals (1.47%) were found seroreactive, and on herd level, out of 9 herds tested, 2 (22.2%) herds were seropositive and 7 (77.8%) were seronegative. In Togdheer, out of 264 tested cows (11 herds), 4 (1.52%) animals were found seropositive, and on herd level out of the 11 herds tested 4 (36.4%) were seropositive and 7 (63.6%) were seronegative. The distribution of seropositive animals according to age was as follows; at 7 months-1 year age 82 cows were found seronegative (0.0 %), 2-5 years old 2 out of 91 tested cows (2.2 %) found seropositive, 5-8 years of age 5 out of 259 cows (1.7 %) were found seropositive. Prevalence between studied districts according to different age group were different, in Waqoyi Galbed, from 7 month-1 year, from 2-5 years and from 5-8 years were 0.0%, 2.6%, and 1.4% respectively while in Togdheer, they were 0.0%, 1.9% and 1.9% respectively. All tested animal were apparently normal without showing clinical evidence for EBL infection.

Discussion

We used the blocking-ELISA for EBL serosurvey. The commercially available ELISA tests using gpg51 ELISA had analytical

sensitivity and specificity in accordance with (OIE, 2004). It was reported that, an enzyme linked immunosorbent assay (ELISA) and the agar gel immunodiffusion test with bovine leukosis virus glycoprotein as antigen (AGIDT-BLV gp), both tests detected the same number of sera positive or negative for antibodies (Ressang *et al.*, 1981).

In this study, the overall seroprevalence of EBL is relatively low (1.5 %) as out of 468 tested cows collected from 20 herds, 7 cows reacted positively to ELISA. The distribution of seropositive animals according to age was as follows; at 7 months-1 year age 82 cows were found negative (0.0 %), 2-5 years old 2 out of 91 tested cows (2.2 %) found positive, 5-8 years of age 5 out of 259 cows (1.9 %) were found positive. According to the district of the animals tested, in Waqoyi Galbed out of 204 tested cows from 9 herds, 3 (1.47%) were found positive. In Togdheer, out of 264 tested cows (11 herds), 4 (1.52%) were found positive. Prevalence between studied districts according to different age group were different, in Waqoyi Galbed, from 7 month-1 year, from 2-5 years and from 5-8 years were 0.0%, 2.6%, and 1.4% respectively while in Togdheer, they were 0.0%, 1.9% and 1.9% respectively. Other studies often included cattle over 5 and 7 years of age (Jacobs *et al.*, 1995).

The percentage of seropositive animals is very low, or else those farms are completely leukosis-free as spread of the disease is found to be low. These show that the country remains free from the disease and is unlikely to present as an outbreak. However herds with this disease might consider management strategies to eliminate it from their herd in consultation with the veterinary authorities. However, in some situations, serologic tests may fail to identify infected animals. Some examples of these situations are the birth (Ebertus *et al.*, 1987), (Gentile *et al.*, 1985), recently infected animals (it is possible that in some cases antibody detection occurs just only three weeks after infection (De Boer *et al.*, 1987).

Permanently seronegative animals, transient or permanent low level of antibodies, and animals simultaneously infected with BVDV which show depressed immune response to BLV (Klintevall et al. 1994). The infection stage, host-virus interactions, including the number of infected cells or the number of copies of proviral DNA per cell, the regulation of viral antigen expression, the immune response induction and the lymphocyte proliferation may all, directly or indirectly, influence the BLV detection (Roberts et al., 1989).

Previous seroepidemiological studies using the ELISA yielded rather high infection rates 36% (Cockerell and Rovnak, 1988). These researchers explained that high infection rates were caused by; intensive close physical contact among animals, intensive management practices, importation of dairy cows from the USA, Germany, Austria, Canada and Holland (infection with BLV is widespread in these countries). Several authors indicated that (Smirnov, 1991), (Petrov, 1997), (Rusinovich and Drogun, 1998), (Di-Giacomo, 1992), (Pelzer and Sprecher, 1993), (Sprecher et al., 1991), (Stokka, et al., 1998) showed that depending on the severity of the epidemiological process, eradication of leukosis from bovine herds could be achieved in 5 or 10 Years. However, loss of international markets and the effect of adverse publicity on the domestic market, have the potential to be economically disadvantageous for the dairy industry, hence the motivation for the national eradication programme.

Consequently, unidentified virus carriers remain in the herd and are a source of further BLV infections. This situation has an important effect on the eradicating of BLV infection and on the protection of leukosis-free herds against the introduction of BLV infected animals. According to Kettmann, et al., (1994), false-negative results obtained in the ELISA can be obtained for animals in the early BLV-infection phase and when there is no detectable humoral response, since the BLV antibody synthesis begins a few weeks

after the infection. Moreover, ELISA results obtained in young calves may also indicate BLV infection of non-infected animals. False-positive results occur when non-infected calves are fed colostrum, which is the source of the gp51 antibodies. According to some authors, the bovine leukaemia viral protein expression may have a temporary character and cause the periodical disappearance of antibody titers in blood serum to an undetectable level in a serological test. The lack of detectable specific antibodies in BLV-positive animals may also be caused by mutations within the env gene, which encodes antigen epitopes that determine the immunological properties of gp51 glycoprotein (Bicka, et al., 2005), (Reichert, 2002).

These mutations may modify the antigenicity of the viral envelope protein and thus considerably reduce ELISA sensitivity, especially when the test detects only antibodies targeted against one epitope.

It was anticipated that this epidemiological study would provide useful information in making decisions about the needs for, and direction of planned interventions in the Somali bovine pastoral system. We consider that detection programmes for EBL, must include large dairy populations in further studies. Although serological test does not provide information of the infection at the early stage and is not sensitive enough to detect every infected animals, elimination of seropositive animals and prohibition of introduction of seropositive animals are sufficient to promote BLV-free herds in Somaliland.

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ETAT DE LA TRYPANOSOMOSE CHEZ LES BOVINS N'DAMA ET ÉVALUATION DE L'UTILISATION DES TRYPANOCIDES DANS LA ZONE COTONNIÈRE DE LA HAUTE GUINÉE (GUINÉE - CONAKRY)

Barry A M¹ and Vial L²

¹DNE, BP 559, Conakry, Guinée. Email: abarrymadiou @yahoo.fr

²CIRAD-EMVT, Campus International de Baillarguet, Montpellier, France.

Résumé

Un état de la trypanosomose dans la zone de Mandiana a été fait pour estimer la prévalence de l'infection à *Trypanosoma* spp chez l'hôte (bovin) et chez le vecteur (glossine). Pour se faire, une enquête transversale parasitologique et entomologique a été réalisée et un questionnaire portant sur l'utilisation des trypanocides a été fourni aux agro-éleveurs de la zone d'étude. L'enquête parasitologique a porté sur 1800 bovins, choisis au hasard dans 30 villages appartenant à la Préfecture de Mandiana (Haute Guinée). Cette enquête a révélé un taux moyen d'infection de 3% pour l'ensemble des villages avec cependant une forte hétérogénéité entre villages, certains pouvant atteindre jusqu'à 12% d'infection. L'enquête entomologique a mis en évidence l'existence de deux espèces de glossines (*Glossina morsitans submorsitans* et *G. palpalis gambiensis*) dans le site d'étude. Au regard de l'utilisation des trypanocides, les agro-éleveurs ont essentiellement recours à deux trypanocides, à savoir l'acéturate de diminazène et le chlorure d'isométymidium. La fréquence des traitements est généralement de 1 à 3 fois par an.

Mots clés: *Trypanosoma* spp. - *Glossina palpalis gambiensis* - *Glossina morsitans submorsitans* - Bovins N'damas - Trypanosomose – Trypanocides -

SURVEY ON TRYPANOSOMIASIS IN N'DAMA CATTLE AND EVALUATION OF THE USE OF TRYPANOCIDAL DRUGS IN THE COTTON BELT OF UPPER GUINEA, IN GUINEA-CONAKRY

Abstract

This study was carried out to identify and evaluate the state of trypanosomiasis in Mandiana area and to estimate the prevalence of *Trypanosoma* spp in the intermediate host (cattle) and in the vector (tsetse fly). Therefore, a cross-sectional parasitological and entomological survey was conducted and a questionnaire on the use of trypanocidal drugs was provided to agro-pastoralists in the study area. For the parasitological survey, 1800 cattle were randomly selected across 30 villages from Mandiana district, in Upper Guinea. The result of the survey indicated an average infection rate of 3% for all the villages, although significant variations were observed between villages, some showing up to 12% of infection. The entomological survey revealed the existence of two species of tsetse flies (*Glossina morsitans* and *Glossina . palpalis submorsitans gambiensis*) in the study area.

Introduction

Les trypanosomoses animales rend approximativement 10 millions de Km² de terre en Afrique inapte à la production du bétail (Njogu *et al.*, 1985). En l'absence de glossines, il serait possible d'élever 33 millions de têtes de bétail supplémentaires, correspondant à une production potentielle de 0.5 millions de tonnes de viande et de 1.6 millions de tonnes de lait par an (Cuisance *et al.*, 2003). Cette maladie engendre des pertes directes telles que la baisse de la fécondité, l'amaigrissement, la diminution de la production laitière et le retard de croissance du bétail. En outre, la trypanosomose animale a un effet négatif sur les bovins de traits et sur les bovins utilisés dans le transport de matériels ou de denrées.

La Guinée est une zone d'endémicité de trypanosomose humaine et la maladie est en pleine recrudescence (Ministère santé, com. pers.).

La Partie Est de la Guinée fait aussi partie de l'aire de répartition géographique des glossines. Au nord-est du pays, en Haute Guinée, les systèmes agricoles et d'élevage sont similaires à ceux du Mali et du Burkina Faso. Les agro-éleveurs sont majoritairement sédentaires. Les bœufs de labours assurent l'essentiel de la production cotonnière. 75% de ces bovins présentent des anticorps spécifiques aux trypanosomes, prouvant leur contact plus ou moins récent avec le pathogène (Barry *et al.*, 2009). Peu de données sont par contre disponibles quant à la prévalence de la trypanosomose et à l'utilisation des trypanocides dans cette zone. L'objectif de cette étude est :

- d'évaluer la prévalence d'infections à *Trypanosoma* spp. en Haute Guinée,
- de fournir une première estimation du risque trypanosomien dans la zone en étudiant à la fois les facteurs intrinsèques d'hôtes pouvant influencer l'exposition et/ou la sensibilité du bétail à la maladie et les facteurs extrinsèques tels que les pratiques d'élevage et la

pression glossinienne,

- d'estimer le risque de chimiorésistance liée à l'utilisation des trypanocides.

Materiel et Methodes

L'étude a été menée dans la préfecture de Mandiana. Elle est située à l'est de la Guinée et présente une frontière avec le Mali et la Côte d'Ivoire. Sa superficie est de 12300 Km² (figure 1). Le climat est de type soudanien (moyennes pluviométriques annuelles de 1300 à 1500 mm et températures moyennes de 15° à 35°C) avec une saison des pluies de mai à octobre et une saison sèche de novembre à avril (Béavogui *et al.*, 1991).

L'élevage est de type traditionnel, sédentaire et extensif. En saison des pluies, les animaux sont rassemblés dans des parcs en forêt ou autour du village. Ils sont quotidiennement conduits aux pâturages par un bouvier. En saison sèche, les animaux restent en divagation à cause de la disette alimentaire et du manque d'eau (Keïta, 2000). L'agriculture est intégrée au secteur de l'élevage. La mise en valeur des terres cultivables se fait grâce à l'apport de la traction animale. Les animaux de trait semblent souvent atteints de trypanosomose et sont traités à l'aide de trypanocides.

Sélection des villages et des bovins

La sélection des villages a été faite à partir d'une liste exhaustive de l'ensemble des villages et des cheptels de bovins dans la Préfecture de Mandiana. Sur 94 villages, 30 ont été choisis au hasard en respectant un pas de trois sur une liste exhaustive comportant les noms des villages. Les villages d'accès difficile ont été éliminés de la sélection. Compte tenu de notre capacité d'observation par jour, 60 bovins âgés de plus d'un an ont été choisis au hasard dans chaque village sélectionné. Les bovins sont regroupés en troupeaux villageois dont le nombre variait entre 1 et 3/village. Chacun des troupeaux a été représenté dans l'échantillon.

Période de l'étude:

Les enquêtes parasitologique et entomologique ont été réalisées pendant la fin de la saison des pluies et au début de la saison sèche. Elles ont commencé en octobre 2002 et se sont achevées en novembre 2002. Le questionnaire sur l'utilisation des trypanocides a été administré aux agro-éleveurs pendant cette même période.

Examen clinique et parasitologique

Les animaux sélectionnés ont tous été prélevés à l'une des veines jugulaires sur tubes avec anticoagulant EDTA. La recherche des trypanosomes a été effectuée par la technique de centrifugation en tube à hématocrite suivie de la lecture du PCV (Packed Cell Volume) et de l'examen de l'interphase au microscope à fond noir (Murray *et al.*, 1977).

Pour chaque animal, il a été enregistré son âge, son sexe, son état corporel, les traitements trypanocides administrés durant les trois mois précédant l'étude, ainsi que son appartenance à un village et un troupeau. Concernant l'état corporel de l'animal, nous avons défini 3 catégories : 1) animal avec le poil lisse, non anémié et présentant un bon état physique) ; 2) animal présentant de réels signes de maigreur, des côtes proéminentes, une faiblesse physique, le poil piqué et un larmolement des yeux) ; 3) animal avec le poil piqué, présentant une légère perte de poids, une anorexie et un état physique douteux.

Enquête entomologique

Six cents pièges biconiques « Challier-Laveissière » ont été posés dans les 30 villages étudiés, à raison de 20 pièges par village (10 pièges en forêts galeries et 10 en savanes). Les pièges ont été disposés à 100 m les uns des autres et examinés après 24 heures de pose (Djiteye *et al.*, 1997). Les mouches capturées ont été disséquées sur place puis observées sous une loupe binoculaire afin de déterminer leur espèce et leur état d'infection (Itard, 2000).

Enquête sur l'utilisation des trypanocides

173 éleveurs (5 ou 6 / village), choisis au hasard en respectant un pas de trois sur une liste nominative, ont été questionnés concernant leur utilisation des trypanocides (catégories d'animaux traités, critères de traitement, trypanocides utilisés, fréquence des traitements, personne responsable des traitements (Bocader, 2001). Nous leur avons aussi demandé d'évaluer personnellement les échecs de traitement dus à une potentielle résistance aux trypanocides.

Analyses statistiques

Les prévalences d'infection à trypanosomes et les densités apparentes de glossines dans les villages ont été calculées. Les villages ont été comparés par des tests non paramétriques de Mann-Whitney et Kruskal-Wallis à l'aide du logiciel STATA 8.0 (Rabe-Hesketh *et al.*, 2004).

De la même manière, les prévalences d'infection ont aussi été calculées pour chaque facteur d'hôte (âge, sexe, état clinique, PCV et traitement antérieur). Afin d'évaluer la relation entre l'état infecté et ces facteurs, ces derniers ont été inclus comme variables explicatives d'une régression logistique réalisée à l'aide du logiciel STATA 8.0, et ont été testés par la méthode du maximum de vraisemblance. Les variables explicatives catégorielles ont été dichotomisées en variables muettes binaires pour les besoins du modèle. Les différences de prévalence d'infection observées entre villages ont été prises en considération en indiquant un effet aléatoire « village » (random effect) dans le modèle (Hedeker, *et al.*, 1994). Cet effet aléatoire a été testé par l'indicateur « rho » correspondant à la part de variance du modèle expliquée par la variable « village » (Browne, *et al.*, 2003). Enfin, le modèle a été ajusté « pas à pas » en ajoutant étape par étape les variables explicatives et en jugeant de leur effet par la méthode du maximum de vraisemblance.

Résultats

Description et distribution spatiale des infections

A l'issue de l'enquête transversale parasitologique, la prévalence moyenne des infections à *Trypanosoma* spp. était de 3% (56/1800). L'infection simple à *Trypanosoma brucei* était présente chez 57% (32/56) des animaux infectés, suivie de *Trypanosoma congolense*, chez 30% des animaux (17/56) et de *Trypanosoma vivax*, chez seulement 2% des animaux (1/56). Le taux d'infection mixte était de 11% (6/56), dont 2% d'associations à *T. congolense* et *T. vivax* et 90.9% d'associations à *T. brucei* et *T. congolense* (Tableau I).

Des différences significatives de prévalences d'infection ont été notées entre villages avec des taux variant de 0% à 12% ($P < 0.001$ par le test de Kruskal-Wallis). Les infections les plus fortes ont été enregistrées à Dialakoro et Kanifra avec des taux de 12% et 10% respectivement ; des taux de 8% ont été trouvés pour Saladou, Kodiaran et Magana (Tableau II).

Prévalence d'infection et facteurs d'hôte

Le modèle de régression logistique a montré que les animaux présentant un état clinique mauvais étaient significativement plus infectés 7% (8/113) que ceux avec un état clinique passable 2,6% (34/1304) (Tableau III).

Dans notre modèle, aucune autre différence significative n'apparaissait concernant les autres facteurs d'hôte testés. Les individus infectés et non infectés présentaient des gammes de PCV quasi similaires (entre 31.2 ± 5.4 et 29.8 ± 5.1) (Tableau IV).

Toutes les classes d'âge d'animaux étaient touchées par la maladie avec des taux respectifs pour les classes de 0-24, 25-49, 50-74, 75-100, >100, de 3.64 (9/247); 2.16 (6/278); 4.71 (17/361); 2.83 (15/529); 2.34 (9/385). Les taux d'infection ont été respectivement pour les animaux traités

et non traités de 2.00% (6/299); 3.33 (50/1501).

Par rapport au sexe, les femelles 2.38% (43/1800) semblaient plus infectées que les mâles 0.72% (13/1800) mais cette différence n'était pas significative (Tableau V).

L'effet aléatoire de la variable « village » était par contre fortement significatif ($\chi^2 = 12.97$, $p < 0.001$) et expliquait une grande partie de la variance du modèle ($\rho = 0.23$).

Enquête entomologique

L'enquête entomologique a mis en évidence la présence de deux espèces de glossines : *Glossina palpalis gambiensis* et *Glossina morsitans submorsitans*

Pour la première espèce, 431 glossines ont été capturées dans 25 sites. 113. Pour la seconde espèce, 28 glossines ont été capturées dans 6 sites (Tableau VI).

58 glossines des deux espèces, ont été disséquées ; une seule glossine, capturée à Kaman, était infectée soit une prévalence d'infection des spécimens disséqués de 0,2% (1/58) L'agent pathogène infectant a été trouvé dans le labre et l'hypopharynx uniquement ce qui semblerait indiquer une infection à *Trypanosoma vivax*.

Utilisation des trypanocides

Après dépouillement des questionnaires, 44% des 173 agro-éleveurs interrogés ne faisaient pas de discrimination pour traiter leurs animaux, 34% ne traitaient que les bœufs de trait contre 22% pour les vaches. 17% des éleveurs administraient du Trypanidum; 16% du Bérenil; 60% les deux à la fois; 7% sans information. L'intramusculaire semble être l'unique voie d'administration des trypanocides. La fréquence des traitements était de 1 à 3 administrations par an (1 fois : 12%, 2 fois : 32% et 3 fois : 25%) et rarement plus. 76% des éleveurs semblaient se baser sur les symptômes évocateurs de la trypanosomose pour traiter leurs animaux; 14% utilisaient des trypanocides à la fois en traitement, sur

détection des symptômes, et en prophylaxie; 1% faisaient uniquement de la prévention; et 2% traitaient sur des symptômes vagues de maladie; 7% n'ont pas donné de réponses.

Enfin, les structures étatiques vétérinaires semblaient fortement impliquées dans le traitement des animaux contre la trypanosomose, en assurant totalement

le traitement chez 40% des agro-éleveurs et partiellement chez 17%; 34% assurant le traitement sont non professionnels; 9% n'ont pas donné de réponse. Les circuits d'approvisionnement en trypanocides font appel aussi bien aux systèmes formels qu'informels (système mixte: 41%, formel: 27%, informel: 12%, sans information: 20%).

Tableau I: Les fréquences des trypanosomes des bovins dans les villages enquêtes de Mandiana

Villages	Type d'infection			
	<i>T.congolense</i>	<i>T.vivax</i>	<i>T.brucei</i>	Mix infection
Balandou	0	0	3	0
Balandougouba	0	0	0	0
Bougoula	1	0	0	0
Dialakoro	1	0	5	1TcTb
Diarakourou	0	0	0	0
Guilengbè	0	1	0	0
Kaman	0	0	0	0
Kaméréna	1	0	2	0
Kanifra	3	0	2	1TcTb
Kansan	0	0	1	1TcTb
Kantoumanina	1	0	0	0
Karakoura	1	0	3	0
Kignékoura	0	0	0	0
Kignéni	0	0	2	1TcTb
Kinieran centre	1	0	0	0
Kignérankoura	0	0	0	0
Kodiaran	2	0	3	0
Konkoye	0	0	4	0
Konomakoro	0	0	0	0
Loilakoro	0	0	0	0
Magana	0	0	5	0
Missima	0	0	1	0
Morodou	0	0	0	0
Niantanina	2	0	0	0
Saladou	4	0	0	1TcTv
Sansado	0	0	0	0
Sidikila	0	0	0	0
Sountoudiana	0	0	1	0
Wassa	0	0	0	0
Wolola	0	0	0	1TcTb
Total	17	1	32	6

Tableau II: Taux d'infection des bovins par les trypanosomes dans les villages enquêtes de Mandiana

Village	Effectifs	Nombre d'Infectés	Pourcentage infection
Balandou	60	3	5(3/60)
Balandougouba	60	0	0
Bougoula	60	1	1,7(1/60)
Dialakoro	60	7	12(7/60)
Diarakourou	60	0	0
Guilengbè	60	1	1,7(1/60)
Kaman	60	0	0
Kaméréna	60	3	5(3/60)
Kanifra	60	6	10(6/60)
Kansan	60	2	3,3(2/60)
Kantoumanina	60	1	1,7(1/60)
Karakoura	60	4	6,7(4/60)
Kignékoura	60	0	0
Kignéni	60	3	5(3/60)
Kinieran centre	60	1	1,7(1/60)
Kignérankoura	60	0	0
Kodiaran	60	5	8,3(5/60)
Konkoye	60	4	6,7(4/60)
Konomakoro	60	0	0
Loïlakoro	60	0	0
Magana	60	5	8,3(5/60)
Missima	60	1	1,7(1/60)
Morodou	60	0	0
Niantanina	60	2	3,3(2/60)
Saladou	60	5	8,3(5/60)
Sansado	60	0	0
Sidikila	60	0	0
Sountoudiana	60	1	1,7(1/60)
Wassa	60	0	0
Wolola	60	1	1,7(1/60)
Total	1800	56	
Moyenne			3(56/1800)

Tableau III: Effet de l'infection sur l'état clinique de l'animal

Etat	infectés	non infecté	Total
Bon	14	369	383
Passable	34	1270	1304
Mauvais	8	105	113
Total	56	1744	1800

Tableau IV: Effet de l'infection sur le PCV

Bovins	Nombre	Moyenne de PCV
Infectés	56	31.2 ± 5.4
Non infectés	1744	29.8 ± 5.1
Total	1800	29.9 ± 5.1

Tableau V: Effet du sexe sur l'infection

Sexe	Positif	Négatif	Total
Femelle	43	1128	1171
Mâle	13	616	629
Total	56	1744	1800

Tableau VI: Nombre de glossines capturées et densité apparente par village

VILLAGE	G. palpalis gambiensis	G. morsitans submorsitans	Densité ^a
Balandougou	28	0	1.4 ± 7,62
Balandougouba	9	0	0.45 ± 4,65
Dialakoro	6	0	0.3 ± 2,06
Guilengbè	0	0	0
Kaman	31	0	1.55 ± 11,18
Kamerena	0	0	0
Kanifara centre	0	0	0
Kansan	3	0	0.15 ± 1,10
Karakoura	10	0	0.5 ± 3,72
Kignekoura	0	0	0
Kinieran centre	3	0	0.15 ± 1,30
Kinierankoura	30	0	1.5 ± 7,97
Konkoye	26	0	1.3 ± 7,35
Konomakoro	9	0	0.45 ± 2,47
Loïlakoro	14	0	0.7± 4,20
Magana	0	0	0
Sansado	7	0	0.35 ± 2,77
Sidikila	9	4	0.45 ± 1,89
Wolola	1	0	0.05 ± 0,58
Bougoula	37	1	1.85 ± 10,10
Diarakourou	17	17	0.85 ± 5,13
Kantoumanina	30	1	1.5 ± 8,00
Kigneni	10	0	0.5 ± 2,67
Kodiaran	21	0	1.05 ± 6,21
Missima	1	0	0.05 ± 0,52
Morodou	2	0	0.1 ± 0,84
Niantanina	4	0	0.2 ± 1,82
Saladou	115	3	5.75 ± 22,74
Sountoudiana	1	0	0.05 ± 2,25
Wassa	7	2	0.35 ± 2,25
Total	431	28	459
DAP	0,7(431/600)	0,05(28/600)	0,77(459/600)

a = nombre de mouches/piège/jour

Discussion

L'étude révèle que la prévalence d'infection à *Trypanosoma* spp. chez les bovins de la zone d'étude est assez faible (3%). Cependant, des différences importantes existent entre villages. Certains sont totalement indemnes de trypanosomose alors que d'autres présentent une prévalence pouvant atteindre 12%.

Selon les résultats de l'enquête entomologique, il ne semble pas exister de relation entre la pression glossinienne et la prévalence d'infection, exception faite à Saladou où une prévalence en *Trypanosoma* spp de 8.3% répond à une DAP de $5.75 \pm 22,74$. *G. palpalis gambiensis* est répartie de façon assez homogène sur l'ensemble de la zone d'étude qui présente de nombreux cours d'eau favorables à l'installation de cette espèce. *G. morsitans submorsitans* est par contre assez rare. Les faibles DAP observées pour cette espèce dans certaines zones pourraient s'expliquer par une moindre efficacité des pièges biconiques pour les captures de glossines de savane comme *G. morsitans submorsitans* (Halos, 2002). L'augmentation des densités de population humaine et le développement des espaces cultivés sont des facteurs limitant l'abondance des glossines de savanes (Diall, com. pers.).

Le taux d'infection des glossines examinées était particulièrement faible ; il est probable que le nombre de glossines disséqué (51 glossines sur 459 capturées) ait été insuffisant ou qu'il existe un problème de sensibilité (ex: dissection de glossines mortes). Il existe en effet une certaine incohérence entre la prévalence élevée de trypanosomes chez les bovins prélevés lors de l'étude et le faible taux d'infection des populations de glossines (Itard, 2000).

Les fortes prévalences d'infection des bovins de certains villages pourraient s'expliquer par le management du troupeau (abreuvement aux puits des villages ou à la rivière la plus proche), par les parcours saisonniers des animaux, ou par

l'emplacement des parcs à bétail de certains villages qui sont installés hors du village en pleine forêt, tous ces facteurs favorisant le contact glossine-bovin. En outre, dans certains villages, les animaux sont exposés à un stress nutritionnel par la limitation de leur aire de pâturage en saison de culture, certains agro-éleveurs n'ayant pas prévu des zones de pâturage pendant cette période.

Lors de l'étude, les infections à *T. brucei* étaient prédominantes, suivies par celles à *T. congolense*, espèces de trypanosomes particulièrement importantes du point de vue sanitaire. Notre étude ne montrait pas de multiparasitisme fréquent. Ce résultat peut être lié à la sensibilité du BCT, qui attribue généralement l'infection au parasite qui se trouve en plus grand nombre dans le sang (Nyeko *et al.*, 1990). Concernant les facteurs d'hôtes, les troupeaux présentant les plus forts taux d'infections sont constitués d'animaux majoritairement en mauvais état sanitaire, ce qui laisse supposer qu'à l'intérieur de la race trypanotolérante, des animaux susceptibles existent et expriment la maladie. Les faibles différences de PCV entre animaux malades et sains prouvent cependant que les animaux sont suffisamment trypanotolérants pour contrôler la parasitémie et l'anémie lors d'une infection, même si leur état sanitaire peut être affaibli (Trail, *et al.*, (1993). Les femelles sont 2 fois plus infectées que les mâles.

Toutes les classes d'âges semblent être touchées par la trypanosomose. Dans la zone de Mandiana où la trypanosomose est endémique, toutes les classes d'âges présentent le même degré d'exposition. Les pratiques d'élevage et de traitement n'épargnent pas les jeunes animaux à l'infection.

L'enquête sur les pratiques d'élevage montre que les trypanocides sont fortement utilisés dans la zone de Mandiana. Les pratiques de traitement sont fortement hétérogènes et ne semblent pas toujours cohérentes avec une optimisation de l'efficacité des trypanocides. Enfin,

certains produits sont distribués de façon informelle; il est difficile de vérifier leur nature et leur dosage. Le fait que certains villages présentent de fortes prévalences d'infection à *Trypanosoma spp*, en dépit de l'utilisation de trypanocides, laisse suspecter l'existence d'une chimiorésistance ou une mauvaise gestion des trypanocides usuels. Une étude de terrain dans les villages à forte prévalence d'infection à trypanosomes semble nécessaire pour estimer la proportion de bovins hébergeant des trypanosomes résistants aux trypanocides. Cette information recueillie permettra d'élaborer des stratégies de contrôle de la trypanosomose dans la zone.

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HAEMATOLOGICAL, CARCASS CHARACTERISTICS AND MEAT QUALITY OF INTENSIVELY MANAGED WEST AFRICAN DWARF GOATS SLAUGHTERED AT DIFFERENT LIVE WEIGHTS

Fasae O A, Ibikunle B A, Oyenaiya O A and Adu I F.

Department of Animal Production and Health, University of Agriculture, P.M.B. 2240, Abeokuta, Nigeria.

Abstract

The West African Dwarf (WAD) breed of goats was slaughtered at live weights (LW) of 10, 12, 14, and 16kg to determine the effect of live weight at slaughtering on the carcass characteristics and meat quality. Prior to slaughtering, blood samples were collected through jugular vein of each animal to determine the haematological parameters. The haematological parameters monitored varied ($P < 0.05$) across the treatments with goats slaughtered at 10 to 12kg LW having significantly ($P < 0.05$) lower values with exception of blood glucose and total protein. Carcass characteristics also differed significantly ($P < 0.05$) with goats slaughtered at 14 and 16kg LW having significantly ($P < 0.05$) higher values. DM contents of the meat was not influenced ($P > 0.05$) by LW at slaughter but crude protein, fat, ash contents and pH values differed significantly ($P < 0.05$) across the treatments. In sensory evaluation, panelists rated texture and juiciness the same ($P > 0.05$), while colour of meat from goats slaughtered at 10kg LW was rated low ($P < 0.05$). Meat of goats slaughtered at 10 and 12kg LW was more tender ($P < 0.05$) compared with that of those slaughtered at higher LW while overall acceptability was rated high ($P < 0.05$) for goats slaughtered at higher LW. It was however, concluded that the haematological parameters, carcass characteristics and meat quality of West African dwarf goats differ with LW at slaughter. Goats slaughtered at 14 and 16kg LW produced high DP and their meat was most acceptable to the panelist on account of preference.

Key words: Goats, live weight at slaughter, haematological, carcass, meat quality

CARACTÉRISTIQUES HÉMATOLOGIQUES DES CARCASSES ET QUALITÉ DE LA VIANDE DES CHÈVRES DJALLONKÉ ÉLEVÉES EN SYSTÈME INTENSIF ET ABATTUES SOUS DIFFÉRENTS POIDS VIFS

Résumé

Les chèvres de race Djallonké ont été abattues sous poids vif (PV) de 10, 12, 14, et 16kg en vue de déterminer l'effet du poids vif à l'abattage, sur les caractéristiques de la carcasse et sur la qualité de la viande. Avant l'abattage, des prélèvements d'échantillons de sang ont été effectués par la veine jugulaire de chaque animal afin d'en déterminer les paramètres hématologiques. La surveillance des paramètres hématologiques mis en évidence a permis de constater une variation de l'ordre de ($P < 0.05$) au cours des traitements des caprins abattus sous poids vifs de 10 à 12kg. Ces derniers présentent, en effet, des valeurs extrêmement faibles ($P < 0.05$), à l'exception du glucose sanguin et des protéines totales. Les caractéristiques des carcasses présentent également des différences significatives de l'ordre de ($P < 0.05$) par rapport aux caprins abattus sous poids vifs de 14 et 16kg dont les valeurs sont nettement supérieures de ($P < 0.05$). La teneur en matières sèches de la viande n'a pas été conditionnée ($P > 0.05$) par le poids vif de l'animal lors de l'abattage. Les teneurs en protéines brutes, en matières grasses, en cendres et en pH, ont par contre, laissé apparaître des différences notoires ($P < 0.05$) au cours de leurs traitements. Durant l'évaluation sensorielle de la viande, les chercheurs ont noté une parité évidente ($P > 0.05$) entre la texture et la jutosité de la viande des deux groupes et ont fait valoir, toutefois, que la couleur de la viande des caprins abattus

Corresponding author: animalexp@yahoo.co.uk

sous poids vif de 10 Kg ($P < 0.05$) est moins vive. Par contre, la qualité de la viande des caprins abattus sous poids vifs de 10 et 12kg ($P < 0.05$) est plus tendre que celle des caprins abattus sous poids vifs supérieurs à 12 kg alors que l'acceptabilité globale a été jugée supérieure ($P < 0.05$) pour les caprins pour les caprins abattus sous poids vifs plus élevés. Les chercheurs ont toutefois conclu que les paramètres hématologiques, les caractéristiques de la carcasse et la qualité de la viande des chèvres Djallonké diffèrent en fonction du poids vif de l'animal lors de l'abattage. Des caprins abattus sous poids vifs compris entre 14 et 16kg, l'on a tiré des produits de haute qualité et de la viande très acceptable, selon les critères de préférence des chercheurs.

Mots clés: Chèvres/caprins, poids vif lors de l'abattage, hématologique, carcasse, qualité de la viande

Introduction

Goats are important animals in subsistence agriculture in Nigeria. The West African dwarf (WAD) goats are predominantly found in the southern part of Nigeria, which is humid and favours high prevalence of diseases (Oni, 2002). The eco-zone is infested with tsetse fly and the WAD goat thrive well and reproduce with twins and triplet births in the ecological niche (Adeloye, 1998), thereby satisfying a part of the meat requirement in this region. Goat meat has been established as lean meat with favourable nutritional quality. Its attributes are concordant with present day consumer demands for leaner and nutritious meat (Webb *et al.*, 2005)

Goats in Nigeria are usually slaughtered at various weights at the owners' discretion which results in low and poor carcass yield and quality. The preference of goat meat may be due to special features, which makes it more organoleptically different from mutton, and on weight basis goat meat has higher lean meat content than mutton and less wastage (Devendra and Owen, 1983). The relative importance of goat meat in the tropics is associated with its wide distribution especially on small farm holdings where goats play an important role in contributing meat and milk as well as providing some income (Adu *et al.*, 1996). Since goat production in south western Nigeria is focused on the WAD breed and because of its numerical importance, there is need to quantify its health status and carcass characteristics. The

present study was conducted to provide primary information on the haematological parameters which is a fair indication of whether animals are oversupplied or undersupplied with nutrients, as well as for diagnosing the production status of these animals (Daramola *et al.*, 2005), and also the carcass characteristics as well as the meat quality of WAD goats managed intensively and to examine the changes in composition that may be influenced by live weight at slaughter.

Materials and Methods

Sixteen (16) West African Dwarf male goats of various live weights ranging from 10 to 16kg managed under the intensive system at the Teaching and Research farms of the University of Agriculture, Abeokuta, Ogun State, Nigeria were used for the study. The goats were randomly allocated to four treatments of four replicates, balanced for weight in a completely randomized design. They were fed fresh *Panicum maximum ad-libitum*, supplemented with 17% concentrate with water provided *ad-libitum*. A day to slaughtering, blood samples were collected from the jugular vein into lithium heparin tubes and centrifuged at 3000rpm for 15 minutes at 4°C. Plasma was harvested and stored at -20°C until analyzed.

The goats were then fasted for 24hours, weighed and slaughtered at different predetermined weights of 10, 12, 14 and 16kg according to the local method of severing the jugular veins, throat and trachea without stunning. After thorough

bleeding, the hair was scalded from the skin using boiling water. Empty body weight was computed by subtracting the weight of the gut content from the slaughter weight. The hot carcass weight was weighed by removing the head, feet and gastric intestinal tract within one hour of slaughter with organs being carefully excised, weighed and chilled for 24 hours at 4°C, and then weighed again to determine the cold carcass weight. The carcasses were cut into retail parts (shoulder, rack, loin, legs, neck/breast, and shank/flank) and each part was weighed as described by Adu and Brinckman (1981) and calculated as percentage of empty body weight. The dressing percentage was calculated as the ratio of cold carcass weight to live weight in percentage.

In evaluating the sensory qualities, samples of meat from loin in each treatment were collected, tagged for identification, put in a double layered polythene bags and cooked in water at 80°C for 40 minutes in a pot. Ten panelists were trained in the assessment procedure and were subsequently required to masticate on a sample each from each treatment and score it for flavour, tenderness, juiciness and overall degree of acceptability (Iwe, 2002). The evaluators scored each sample on a nine (9) points category rating scale (9 = like extremely; 8 = like very much; 7 = like moderately; 6 = like slightly; 5 = neither like or dislike; 4 = dislike slightly; 3 = dislike moderately; 2 = dislike very much; 1 = dislike extremely) (AMSA, 1978) for colour, juiciness, flavour, texture, tenderness while overall acceptability was scored on a 3 point scale (1 = least acceptable; 2 = more acceptable and 3 = most acceptable).

Chemical analysis

The Dry Matter content of the meat was determined by oven drying at 100°C for 24 hours, crude protein by Kjeldahl method, fat by Soxhlet extraction using petroleum ether, and ash content was measured through ashing in a furnace at 500°C for 6 hours (AOAC, 1990). Meat

Table 1: Composition of diets (%) fed West African dwarf goats slaughtered at different weights

Ingredients	Concentrate	Panicum maximum
Wheat offal	40	-
Corn offal	35	-
Palm kernel cake	22	-
Bone meal	2	-
Mineral /salt mixture	1	-
Total	100	
Determined analysis (%)		
Dry matter	85.54	89.82
Crude protein	17.20	9.14
Crude fibre	12.11	3.65
Ether extract	3.63	1.64
Ash	9.35	13.86

sample (10g) homogenized in distilled water (90ml) was used to measure the pH value using pH meter (Ockerman, 1985).

Statistical analysis

Data generated were based on completely randomized design and subjected to one way analysis of variance using the statistical package (SAS, 1999). Significant means were separated using Duncan Multiple Range Test (Duncan, 1955).

Results and discussion

The chemical composition of feed fed the experimental goats is shown in Table 1. The chemical composition of *Panicum maximum* is comparable to that reported by Bamikole *et al.*, (2001) and higher than that reported by Fasae *et al.*, (2009). Feeding *Panicum maximum* supplemented with concentrate has been found to support growth in goats (Isah *et al.*, 2007).

The haematological parameters of WAD goats differed significantly ($P < 0.05$) across the weight groups (Table 2). The packed cell volume (PCV) observed in

this study were higher than values reported for the same breed of goat (Orheruata *et al.*, 2004). This might be attributed to the intensive system of management practiced with goats in this study which could be responsible for proper maintenance of their PCV. Grazing goats have been reported to have a reduction in PCV of about 9-11% due to grazing stress and in sufficient protein intake (Blood *et al.*, 1989). However, goats slaughtered at higher live weights (LW) had significantly ($P < 0.05$) higher PCV values compared with goats of lower weights. The values obtained for red blood cells and white blood cells (WBC) were higher ($P < 0.05$) in heavier goats. WBC values among the treatments compared well with the range obtained for WAD goats (Daramola *et al.*, 2005; Fasae *et al.*, 2005) and higher than the range reported for Red Sokoto goats (Tambuwal *et al.*, 2002). This suggests that WAD goats possess protective mechanism thereby providing a rapid and potent defense against infectious agent, which confirms its ability to thrive well and reproduce in the eco zone infested with tsetse fly (Adeloye, 1998; Oni, 2002). The values obtained for blood glucose level and total protein were similar ($P > 0.05$) across the weight groups and were within the range reported for goats (Puls, 1994) under different management systems.

The carcass characteristics of WAD goats in this experiment varied ($P < 0.05$) across the weight groups (Table 3).

Carcass weight increased with live weight as heavier goats dressed higher ($P < 0.05$) than the lighter goats by about 2-3%. This is in consonance with the findings of Singh *et al.*, (1994) where there was a significant increase in carcass characteristics of Bengal goats due to LW at slaughter. However, differences were not observed in the percentages of the retail components across the weight groups. The dressing percentage (DP) of goats slaughtered at 14 and 16 kg LW were similar but higher ($P < 0.05$) compared to the other weight groups. However, DP has been reported to be influenced by age, weight, sex, body condition, amount of gut fill at slaughter, whether the carcass is weighed hot or cold and, of course, by the number of body components included in the yield calculation (Pike *et al.*, 1993). Marichal *et al.* (2003) also observed variation in DP of carcass from Canary breed of goats based on live weight. The carcass yield and characteristics of WAD goats among the weight groups in this study were however similar to those reported for brown Bengal goats (Singh *et al.*, 1994).

The proximate composition of meat from loin of WAD goats slaughtered at different LW is shown in Table 5. The dry matter (DM) content of goat meat across the treatments was closely related ($P > 0.05$). The crude protein (CP) content was significantly lower in lighter carcasses with goats slaughtered at 10kg LW having the least ($P < 0.05$) percentage. Goats slaughtered

Table 2: Haematological parameters of West African Dwarf goats slaughtered at different live weights

Parameters	Slaughter				SEM
	10	12	14	16	
Packed cell volume (%)	24.55b	25.60b	28.50a	31.40a	0.72
Red blood cells (μ/L)	12.10b	12.30b	13.40a	13.95a	0.34
White blood cells (μ/L)	11.41b	11.94b	12.65a	13.32a	0.22
Blood urea nitrogen (mmol/L)	3.71b	3.95b	4.45ab	4.94a	0.16
Glucose (mmol/L)	3.11	3.07	3.45	3.57	0.12
Total protein (mmg/L)	5.85	5.90	5.73	5.80	0.21

a,b,c Mean values on the same row with same superscripts are not significantly ($P > 0.05$) different

Table 3: Carcass characteristics of West African Dwarf goats slaughtered at different live weights

Parameters	Slaughter Weights (Kg)				SEM
	10	12	14	16	
Slaughter weight (kg)	10.5 ^d	13.5 ^c	15.0 ^b	16.5 ^a	1.04
Empty body weight (kg)	9.11 ^d	12.14 ^c	13.6 ^b	14.78 ^a	0.88
Carcass weight (kg)	4.08 ^b	5.38 ^b	6.10 ^a	6.92 ^a	0.47
Hot carcass weight (kg)	6.42 ^c	7.89 ^b	9.32 ^{ab}	9.72 ^a	0.15
Dressing percentage (%)	38.86 ^b	39.85 ^{ab}	40.67 ^a	41.94 ^a	0.52
Retail cuts (% EBW)					
Leg	22.2	21.8	21.6	21.6	0.13
Loin	13.8	14.3	15.0	15.7	0.14
Shoulder*	14.8	15.4	14.8	14.1	0.09
Rack**	13.5	12.4	12.8	13.2	0.11
Neck/breast	21.3	20.7	21.0	21.1	0.07
Shank/flank	14.4	14.7	14.1	13.9	0.08

a,b,c Mean values on the same row with same superscripts are not significantly ($P > 0.05$) different EBW - Empty body weight

*Shoulder - 5 rib shoulder

**Rack - Included the 6 - 12 ribs.

Table 4: Chemical composition (%) of meat* from West African Dwarf goats slaughtered at different live weights

Parameters	Slaughter weights (Kg)				SEM
	10	12	14	16	
Dry matter	35.12	35.67	35.80	35.64	1.04
Crude protein	26.91 ^c	28.04 ^b	28.91 ^b	30.32 ^a	0.88
Ether extract	7.91 ^b	7.54 ^b	8.65 ^a	8.97 ^a	0.47
Ash	6.11 ^b	6.25 ^b	6.95 ^{ab}	7.14 ^a	0.15

a,b,c Mean values on the same row with same superscripts are not significantly ($P > 0.05$) different

*Meat from loin

Table 5: Sensory properties of meat* from West African Dwarf goats slaughtered at different weights

Parameters	Slaughter weights (Kg)				SEM
	10	12	14	16	
Colour	6.67 ^b	7.33 ^a	7.67 ^a	7.93 ^a	0.04
Texture	6.17	6.67	6.33	6.71	0.08
Juiciness	5.63	5.67	5.43	5.21	0.13
Flavour	6.11 ^b	6.33 ^b	6.95 ^{ab}	7.14 ^a	0.16
Tenderness	6.17 ^b	6.17 ^b	6.67 ^{ab}	7.47 ^a	0.15
Acceptability	1.33 ^c	1.83 ^b	2.87 ^a	2.33 ^a	0.47
pH	6.08 ^b	6.11 ^b	6.30 ^a	6.31 ^a	0.12

a,b,c Mean values on the same row with same superscripts are not significantly ($P > 0.05$) different

*Meat from loin

at 12 and 14kg LW were statistically ($P > 0.05$) similar in CP content while those slaughtered at 16kg LW had the highest ($P < 0.05$) percentage. This corroborates the reports of Arguello *et al.*, (2005) in kids slaughtered at different live weights. The effect of weight at slaughtering on the fat content revealed that fat content increases ($P < 0.05$) with the weight of goats. The fat content of goats slaughtered at LW of 10 and 12kg were not significantly ($P > 0.05$) affected but were significantly ($P < 0.05$) lower than goats slaughtered at 14 and 16kg LW. Richetti *et al.*, (1973) also reported increasing levels of intramuscular fat content with increasing body weight of goats. Also, the ash contents varied significantly ($P < 0.05$) among the treatments.

The variation in chemical composition of meat from WAD goats across the treatments could be attributed to age of goats at slaughtering as live weight increases with age of animals (Abanto, 1999). This corroborates earlier reports by Devendra and Owen (1983) that the chemical composition of lean tissue of meat animals is greatly influenced by body weight and goats do not seem to be an exception of this.

The influence of LW at slaughtering on the sensory properties of WAD goats are summarized in Table 6. The panelists rated the colour of meat from goats slaughtered at 10kg LW to be significantly ($P < 0.05$) darkened compared with the other treatments. This supports the findings of Arguello *et al.*, (2005) in kids of Majorera breed slaughtered at various live weights. In contrast, Locker *et al.*, (1977) reported no variation in the colour of meat from goats slaughtered at different live weights, which might be attributed to breed differences and the nutritional status of the animals coupled with the management system. In a study involving Criollo goats, it was found that as maturity increases, muscle colour became more significantly darkened (Pike *et al.*, 1973) which is not in consonance with the results of this study. Moreover,

panelists rated texture and juiciness equal ($P > 0.05$) across the treatments which can be interpreted to mean that LW at slaughter does not have any influence ($P > 0.05$) on the texture and juiciness of meat from WAD goats. Contrary findings were reported by Carlucci *et al.*, (1998) for young goat meat which might be as a result of age, breed differences and management system. However, goats slaughtered at lower LW were observed to be more tender ($P < 0.05$) with a poorer flavour ($P < 0.05$) compared with the other treatments. Numerous authors (Koothamaraie *et al.*, 1995; Carlucci *et al.*, 1998) found that a smaller area of muscle fibres, which is associated with lower weight animals, gives more tender meat.

The preference of the panelists in this study for meat of goats slaughtered at higher LW could be a result of the fact that most Nigerians prefer tough meat compared to the softer one and meat tenderness has been found to be one of the most important attributes in terms of consumers' satisfaction (Arguello *et al.*, 2005). Overall acceptability was rated high ($P < 0.05$) by the panelists for meat from goats slaughtered at 14 and 16kg LW, which might be attributed to the light colour and better flavour. This supports the reports of Lapitan *et al.*, (2007) that meat consumers prefer light colour meat to darker ones as darker coloured meat may be synonymous with toughness and low quality. On the contrary, Risvik (1994) found that consumers' preferred tender and juicy meat. The variation could be attributed to the type and breed of animals used, management system and the preference of the consumers.

The pH values were significantly ($P < 0.05$) affected by LW at slaughter across the groups with higher values recorded for heavier carcasses. This supports the observations of Marichal *et al.*, (2003) that pH values fell as LW at slaughter of kids increased from 6 to 25kg. However, the pH values after slaughter ranged from 6.08 – 6.31 and were in agreement with those found by other authors (Laskar and Nath,

1995;Arguello *et al.*, 2005).

Conclusion

The haematological parameters of West African dwarf goats differed with the live weight of the animals. This result could however, serve as reference for diagnostic and therapeutic purposes in WAD goats managed intensively. Also, live weight at slaughter had an influence on the carcass characteristics, composition and meat quality of West African dwarf goats. Goats slaughtered at 14 and 16kg LW possess high dressing percentage and their meat was most acceptable to the panelists, on account of preference for their colour, flavour and tenderness. This may serve as an incentive for butchers and could encourage the development of goat meat sector managed intensively.

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STUDY ON GROS TESTICULAR ABNORMALITIES OF RAMS AND BUCKS AT LUNA EXPORT ABATTOIR, MODJO, ETHIOPIA

Hailemariam S¹, Nigussie Z¹, Tolosa Tadele^{1*} and Regasa F²

¹Jimma University College of Agriculture and Veterinary Medicine, P.o.box 378, Jimma, Ethiopia,

²Addis Ababa University, Faculty of Veterinary Medicine, P.O.Box 34, Debre zeit, Ethiopia

Summary

A study was conducted at Modjo, Luna export abattoir on 505 bucks belonging to four native breeds and 253 rams of two native breeds of Ethiopia to determine the type and the incidence of lesions in the testis and epididymis. The animals were selected from the flock for slaughter using stratified random sampling based on breed. Testis and epididymis of various age groups of animals were inspected after careful identification of the animal. During the study, various abnormalities in testis and the epididymis were observed grossly. Testicular atrophy was the most frequent genital abnormality encountered in both species followed by epididymitis in bucks and sperm granuloma in rams. The incidence of sperm granuloma was higher ($p < 0.01$) in rams than in bucks. In rams, the incidence of testicular atrophy ($p < 0.01$) and epididymitis ($p < 0.05$) was significantly associated with age. Breed type significantly ($p < 0.05$) affected the incidence of sperm granuloma in rams, being higher in Adal rams than in Black Head Somali. In bucks none of the abnormalities observed were significantly associated with breed ($p > 0.05$). Generally 17% of total examined animals were unfit for breeding as they have genital abnormalities of unknown etiology. In conclusion, this study demonstrated that testicular atrophy, epididymitis, sperm granulomas and cryptorchidism of unknown etiologies dominated reproductive pathologies in bucks and rams.

Key word: Buck, Ram, Testicular atrophy, local breed, Ethiopia

ETUDE SUR LES ANOMALIES TESTICULAIRES GRAVES RELEVÉES CHEZ LES BÉLIERS ET LES BOUCS DE L'ABATTOIR DE LUNA EXPORT, À MODJO (ETHIOPIE)

Résumé

Une étude réalisée sur 505 boucs de l'abattoir Luna Export de Modjo appartenant à 4 races autochtones et sur 253 béliers de deux races autochtones (locales) de l'Éthiopie. L'objectif de cette enquête est de déterminer le type et la fréquence des lésions constatées dans les testicules et les épидидymes des animaux sélectionnés. Les boucs et les béliers faisant l'objet de la présente étude ont été triés du troupeau destiné à l'abattoir en procédant à un échantillonnage aléatoire stratifié en fonction de leurs races respectives. Les testicules et les épидидymes des animaux appartenant à divers groupes d'âge ont été inspectés après identification minutieuse de l'animal. Durant l'étude, les équipes de recherche ont procédé à une observation non détaillée des diverses anomalies constatées dans les testicules et les épидидymes des animaux concernés. L'atrophie testiculaire a été l'anomalie génitale la plus fréquemment rencontrée chez les deux espèces d'animaux. Cette dernière est suivie de l'épididymite chez les boucs et du granulome de spermatozoïdes chez les béliers. L'incidence du granulome de spermatozoïdes est plus élevée ($p < 0.01$) chez les béliers que chez les boucs. Les béliers présentent une incidence de l'atrophie testiculaire ($p < 0.01$) et de l'épididymite ($p < 0.05$) très étroitement associée à leur âge. Le facteur race joue un rôle effectif très déterminant ($p < 0,05$) dans l'incidence des granulomes de spermatozoïdes chez les béliers, qui est plus élevée chez les béliers de race Adal que chez les béliers de type somalien à tête noire. Aucune des anomalies observées chez les boucs, n'était, de manière convaincante, associée à la race ($p > 0.05$). D'une manière générale,

*Corresponding author: tadeletolosa@yahoo.com

17% de l'ensemble des animaux examinés étaient impropres à la reproduction car ils présentent des anomalies congénitales, d'étiologie inconnue. En conclusion, la présente étude a démontré que l'atrophie des testicules, l'épididymite, les granulomes de spermatozoïdes et la cryptorchidie d'étiologies inconnues ont nettement prévalu parmi les pathologies de reproduction chez les boucs et les béliers.

Mots clés: Bouc, bélier, atrophie testiculaire, race autochtone/locale, Ethiopie

Introduction

Ethiopia has a large small ruminant population and the number estimated around 27 million sheep and 17 million goats (FAO, 1996). However, as in other tropical areas, productivity has been hampered by the low fertility of the breeding herd (Payne and Wilson, 1999). In this regard the male and female animals are the source of reproductive wastage. Although female sub- or infertility is often linked to the productivity problem, the fertility of individual males has a greater influence on herd performance than does the fertility of individual females (McGowan, 2004); as male has undisputed role on determining the number of females, which conceive, there by directly affecting reproductive efficacy (McGowan, 2004). Inadequate reproductive efficiency definitely leads to economic losses, as reproductive merit is more important than growth performance and carcass quality (Yoseph, 2007). Contrary to these facts, fertility studies generally tend to focus on the female with much less emphasis on the male side (Regassa *et al.*, 2003).

Little research has been done so far on comprehensive characterization of the reproductive traits (testicular traits and epididymal traits and sperm morphology) of male goats and sheep in Ethiopia. The research information in utilization of the diversified livestock genetic resource and for various selection programs planned in the future to improve herd fertility and livestock production. In addition to characterization of reproductive traits, genital abnormalities that have heritable effect must be given a due attention when studying the male

reproductive traits in native breeds of Ethiopia (Smith and Sherman, 1994).

Little information is available on the genital abnormalities of small ruminants that would have serious impact on fertility due to uncontrolled breeding practices which is true for bucks and rams of Ethiopia. The role of abattoir studies in the investigation of genital abnormalities has been demonstrated (Regassa *et al.*, 2003). Therefore, the objective of this study were to investigate and provide information on testicular abnormalities in different breeds of goats and sheep and also to assess the effect of age and breed on testicular abnormalities of sheep and goats

Materials and Methods

Study Area and animals

The study was carried out at Modjo, Luna Export abattoir from November 2007 to April 2008. Modjo is located 70 km southeast of Addis Ababa. In the town there are four export abattoirs including Luna Export Abattoir. The altitude of the area ranges 1500-2300m above sea level, with 600-700 mm annual rainfall, and 18°C and 20°C mean minimum and maximum annual temperature, respectively.

Four native breeds of goats: Afar, Boran, Arsi-Bale and Hareghe and two breeds of sheep: Adal (Afar), and Black head Somalis were used for this study. Animals were selected from flock presented for slaughter by stratified random sampling technique. Animals came for slaughter to Abattoir from different market origin such as Metehara, Borena, Harar, Kemissie (South Shoa) and Bale-Ginir and transported by vehicle to the slaughter house.

Study Design

Anti-mortem and postmortem examinations of bucks and rams reproductive tract were carried out and data obtained were recorded during the study time.

During anti-mortem examination, each selected animal was first identified using tags and the ages were determined through dentition. Then the testes and epididymis were carefully examined, visually inspected for degree of asymmetry, abnormal size (unusually big or small), palpated for consistency (softness or firmness) and the mobility of the testicles within the scrotum. *Cryptorchidism* was also determined by palpating the inguinal rings (Regassa et al., 2003).

Post-mortem examinations of the testes and epididymis were carried out immediately after the animals had been slaughtered. The testicles from each animal were identified, labeled and transported to Luna mini laboratory. Examinations for gross pathological changes were performed using visual inspection, deep palpation and serial and systemic dissections (Regassa et al., 2003). Where, visual inspection was to determine the presence of lesion, abnormal discoloration and unusual shape and size, deep palpation was used to determine the consistency of the testis for unusual softness, firmness or fluctuation. Finally, serial and systemic dissections: into the

parenchyma of the testes was also done to detect the presence and extent of any gross pathological changes. Similar dissections were done into the lumen and substance of the epididymis (Regassa et al., 2003). After each examination, the findings were recorded for each animal and associations between abnormal genital conditions and the species, breed or age of the animals were analyzed using χ^2 -test.

Results

Of the total 758 animals examined, 131 (17%) were with one or more genital abnormalities from which 79 (15.6%) were bucks and 52 (2.1%) were rams (Table 1).

Testicular atrophy was the most frequent genital abnormality encountered in both species followed by epididymitis in bucks and sperm granuloma in rams. In 79.4% bucks unilateral atrophied testicles and also 20.6% bilateral atrophied testicles were recorded. Of all the abnormalities encountered in the two species sperm granuloma was the only lesion influenced by species, rams being more affected ($p < 0.01$). The incidence of each genital abnormalities with breed of bucks has showed no statistically significant association ($p > 0.05$) (Table 2). Breed in rams had significant effect ($p < 0.05$) on the occurrence of sperm granuloma, the incidence being higher in

Table 1: Abnormalities of the testes and epididymis in bucks and rams slaughtered at Luna Export abattoir.

	Bucks	Rams	Total
Number examined	505	253	758
Testicular atrophy	34 (6.7%)	22 (8.7%)	56 (7.4%)
Epididymitis	19 (3.8%)	8 (3.2%)	27 (3.6%)
Sperm granulomas	4 (0.8%)	9 (3.6%)**	13 (1.7%)
Cyptorchidism	6 (1.2%)	6 (2.4%)	12 (1.6%)
Heamorrhagic lesions	9 (1.8%)	2 (0.8%)	11 (1.4%)
Testicular calcification	4 (0.8%)	5 (1.8%)	9 (1.2%)
Orchitis	3 (0.6%)	0 (0.0%)	3 (0.4%)
No. with abnormalities	79 (15.6%)	52 (21%)	131 (17%)

** $p < 0.01$ (χ^2 -test)

Table 2: Abnormalities of the testes and epididymis in different breeds of bucks

	Breed				x ² -test
	Afar	Boran	Arsi-Bale	Harerge	
Number examined	125	135	125	120	
Testicular atrophy	8 (6.4%)	14 (10.4%)	7 (5.6%)	6 (5.0%)	NS
Epididymitis	8 (6.4%)	2 (1.5%)	5 (4.0%)	4 (3.3%)	NS
Cytorchidism	3 (2.4%)	0 (0.0%)	2 (1.6%)	1 (0.8%)	NS
Sperm granulomas	1 (0.8%)	2 (1.5%)	1 (0.8%)	0 (0.0%)	NS
Testicular calcification	1 (0.8%)	1 (0.7%)	1 (0.8%)	1 (0.8%)	NS
Orchitis	1 (0.8%)	1 (0.7%)	0 (0.0%)	1 (0.8%)	NS
Heamorrhagic lesions	2 (1.6%)	3 (2.2%)	2 (1.6%)	2 (1.7%)	NS

NS, not significant

Table 3: Abnormalities of the testes and epididymis in different breeds of rams.

	Breed		X ² -test
	Adal	Black Head	
Number examined	n=133	n=120	
Testicular atrophy	14 (10.5%)	8 (6.7%)	NS
Epididymitis	4 (3.0%)	4 (3.3%)	NS
Cytorchidism	2 (1.5%)	4 (3.3%)	NS
Sperm granulomas	9 (6.8%)	0 (0.0%)	*
Testicular calcification	1 (0.7%)	4 (3.3%)	NS
Orchitis	0 (0.0%)	0 (0.0%)	NS
Heamorrhagic lesions	2 (1.5%)	0 (0.0%)	NS

*p<0.05; NS, not significant (X²-test)**Table 4:** Abnormalities of the testes and epididymis in different age groups of bucks.

	Age group		X ² -test
	≤1	>1	
Number examined	361	144	
Testicular atrophy	13 (3.6%)	21 (14.6%)	**
Epididymitis	12 (3.3%)	7 (4.9%)	*
Cytorchidism	4 (1.1%)	2 (1.4%)	NS
Sperm granuloma	1 (0.3%)	3 (2.1%)	NS
Testicular calcification	2 (0.6%)	2 (1.4%)	NS
Orchitis	3 (0.8%)	0 (0.0%)	NS
Heamorrhagic lesions	6 (1.7%)	3 (2.1%)	NS

*p<0.05, **p<0.01 (X²-test); NS, not significant

Black Head Somali (Table 3). All other genital disorders had no statistically significant association ($p > 0.05$) with breed of rams. Bucks >1 years of age were found to be more affected by testicular atrophy and epididymitis than younger bucks. Thus age

had significant effect on testicular atrophy ($p < 0.01$) and epididymitis ($p < 0.05$). However the rest genital disorders observed were not influenced by age factor (Table 4).

The occurrence of cryptorchidism in rams was significantly influenced ($p < 0.05$)

Table 2: Abnormalities of the testes and epididymis in different breeds of bucks

	Age group		X ² -test
	≤1	>1	
Number examined	114	139	
Testicular atrophy	11 (9.6%)	11 (7.9%)	NS
Epididymitis	3 (2.1%)	5 (3.6%)	NS
Cryptorchidism	0 (0.0%)	6 (4.3%)	*
Sperm granuloma	3 (2.1%)	6 (4.3%)	NS
Testicular calcification	1 (0.7%)	3 (2.2%)	NS
Orchitis	0 (0.0%)	0 (0.0%)	NS
Heamorrhagic lesions	1 (0.7%)	1 (0.7%)	NS

* $p < 0.05$; NS, not significant

by age, the frequency being higher in rams with age group greater than one year old. Statistical analyses showed there was no significant effect ($p > 0.05$) on other genital abnormalities observed (Table 5).

Discussion

In this study testicular atrophy and epididymitis were the dominant abnormalities observed in both species of the study population. This finding is in agreement with more of other researchers in Ethiopia (Regassa *et al.*, 2003; Hibre *et al.*, 2001).

The incidence of testicular atrophy in the present study was 7.4% which is slightly lower than earlier reports (Regassa *et al.*, 2003). This could be because of the fact that, in this study, aged animal with small testes had been rejected to minimize castration factor. Testicular atrophy (degeneration/hypoplasia) when viewed with age factor, the incidence was higher in older groups of both bucks and rams. This is in agreement with reports that testicular degeneration increase with age (Hibre *et al.*, 2001; Kafi *et al.*, 2007).

Sperm granuloma has been reported to be a common cause of infertility (Smith, 1986). Sperm granuloma was found to have higher prevalence in rams than bucks in this study and was comparable with previous reports (Regassa *et al.*, 2003). The incidence

of sperm granuloma was higher in Adal breed than in Black head Somali rams. This probably related to high sperm producing capacity after puberty which could result in sperm impaction in the blind end of efferent tubules (Hibre *et al.*, 2001).

Cryptorchidism was the next important testicular abnormality in the present study and the incidence was slightly higher in sheep. This result deviates from other previous reports but the random sampling technique could probably have played some part in the partiality of selection in sampling. Unilateral *cryptorchidism* was by far more common than bilateral *cryptorchidism*. Retention of the testicles has no significant relation with breed of sheep and goats but age factor in rams seem to influence the incidence *cryptorchidism*, for which there was no explanation. The remaining testicular abnormalities encountered in this study were orchitis, hemorrhagic lesions and testicular calcification. All these pathologic lesions were detected in different degrees or severity affecting the testes.

Conclusion

It is known that under traditional breeding practice farmers usually keep sub fertile males in a flock, which subsequently reduces conception rates, leading to culling of productive females. Thus, genital abnormalities in male goats

and sheep could be part of the cause of poor fertility in tropical small ruminants. This study demonstrated that testicular atrophy, epididymitis, sperm granulomas and cryptorchidism of unknown etiologies dominated reproductive pathologies in bucks and rams. Identification of the causes of these abnormalities should be the main consideration in future research.

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STUDIES ON SOME REPRODUCTIVE PARAMETERS OF THE GRASSCUTTER (*Thryonomys swinderianus*) IN SOUTH – WEST NIGERIA

Fadeyi O A¹, Ajala O O¹, Obudu C E^{2*} and Nafarnda W D²

¹Dept. of Veterinary Surgery & Reproduction, University of Ibadan, NIGERIA

²Dept. of Theriogenology & Dept. of Public Health, Faculty of Veterinary Medicine, University of Abuja-NIGERIA

Abstract

A survey of seven grasscutter farms located in Oyo, Ogun and Lagos States, south-west Nigeria was carried out in order to analyze farm records concerning some reproductive parameters such as gestation length, litter size, sex ratio, birth weight and weaning age and weight. The overall objective of the study was to validate existing information, some of which has been inconsistent and often contradictory. Such knowledge is required to encourage prospective farmers adopt captive breeding of the grasscutter and hence reduce the incidence of environmental degradation associated with bush burning which is the usual mode of capture of the animal from the wild. Results indicated that the gestation length of grasscutters was 156.61 ± 1.02 days, litter size of 4.6 ± 0.28 , a sex ratio of 1.45 ± 0.13 males : 1 female, weaning age of 28.56 ± 0.38 and birth weight of 133.55 ± 42.31 g. This study shows that with good management, grasscutters can be weaned at 4 weeks of age in this environment without any adverse effects on the survivability of the young ones, instead of the 6 weeks advocated in certain quarters. This practice would make it possible for farmers to breed their stock twice a year for enhanced profitability.

Key words: Grasscutter, Reproduction, Biology, Fecondity , Nigeria

ETUDES DE CERTAINS PARAMETRES DE REPRODUCTION DU HERISSON/ RAT DES ROSEAUX (*Thryonomys swinderianus*) AU SUD – OUEST DU NIGERIA

Résumé

La présente étude a été réalisée dans 7 fermes des Etats d'Oyo, d'Ogun et de Lagos, au Sud-ouest du Nigeria, spécialisées dans l'élevage du hérisson (rat des roseaux). Son objectif est de faire une analyse des documents disponibles de ces différentes fermes, en vue de découvrir certains paramètres de reproduction de ce rongeur, tels que la durée de gestation, la taille des portées, le rapport numérique entre les mâles et les femelles (sex-ratio), le poids à la naissance, ainsi que l'âge et le poids au sevrage. L'objectif global de l'étude était de valider les informations disponibles dont certains ont été jugées incohérentes et bien souvent en contradiction avec la réalité matérielle. Ces connaissances sont nécessaires pour encourager les éleveurs potentiels à adopter les pratiques/méthodes de reproduction en captivité des hérissons/rats des roseaux et parvenir à réduire ainsi l'incidence de la dégradation de l'environnement résultant de l'allumage des feux de brousse qui, à l'heure actuelle, constitue le mode habituel de capture de cet animal qui vit à l'état sauvage. Les résultats indiquent que la durée de gestation du hérisson/rat des roseaux est de $156,61 \pm 1,02$ jours ; la taille des portées, de $4,6 \pm 0,28$; le rapport numérique entre mâles et femelles, de $1,45 \pm 0,13$ mâle pour 1 femelle ; l'âge au sevrage, de $28,56 \pm 0,38$ et le poids à la naissance, de $133,55 \pm 42,31$ grammes. La présente étude montre qu'avec des procédés rationnels de gestion, il est possible de réduire l'âge de sevrage du hérisson/rat des roseaux à 4 semaines dans le cadre d'élevage en captivité sans moindre répercussion négative sur la survie des jeunes, au lieu des 6 semaines préconisées

*Corresponding Author: ceobudu@yahoo.com

dans certains milieux. Cette pratique permettrait aux éleveurs de doubler la capacité annuelle de reproduction de leur cheptel et de mieux rentabiliser leur production.

Mots clés: Hérisson/rat des roseaux, reproduction, biologie, fécondité, Nigeria

Introduction

The grasscutter (*Thryonomys swinderianus*) is a wild *hystricomorph* rodent related to the porcupine, guinea pig and chinchilla (Wood, 1955; Asibey, 1974a; Baptist and Mensah, 1986; NRC, 1991). It is called Odin (Urhobo), Jauji (Hausa), Oya (Yoruba), Nchi (Igbo) and Grandaulacode (French). The animal is endemic and found only in Africa (Rosevear, 1969; Adoun, 1993). It is exploited in most areas as a source of animal protein (Vos, 1978). The animal's natural habitat is the grassland of the savanna, feeding mainly on grass, but in captivity it will also feed on sugarcane, corn stalks and cassava peelings (Asibey, 1974b). However, its capture from the wild is through the setting of bushfires by hunters with the attendant destruction of the environment (Yeboah & Adamu, 1995; Ntiamoah-Baidu, 1998). To curtail this problem attempts are now being made to domesticate the grasscutter to make it more readily available, gain economic benefit and also reduce the environmental destruction associated with its collection from the wild (Adu et al, 1999). However, these attempts have not been as successful as desired due to a paucity of information on the biology of the species and difficulty in getting it to acclimatize to captivity (Ewer, 1969).

Husbandry, health and reproductive biology have been identified as areas that need to be investigated for the successful domestication of the grasscutter (Adu et al, 1999). Hence, in investigating the biology of the grasscutter, information that would have a direct bearing on its successful breeding in captivity is of utmost importance. Parameters known to enhance the captive breeding of already domesticated animals should be investigated for their applicability in the grasscutter. This study evaluated farm

records on gestation length, litter size, sex ratio, birth and weaning weights in order to provide information for prospective farmers in Nigeria.

Materials and Methods

Study Location

Records were collected from seven grasscutter farms (A – G) located in Oyo, Ogun and Lagos States, all in south-western Nigeria.

Animal Management

The seven farms had similar management procedures which was traceable to the influence of the Grasscutter Farmers' Association of Nigeria (GRAFAN). The Association ensures that every prospective breeder undergoes training before raising grasscutters to forestall in-breeding and ensure selection. The management procedure included the following:

- a) A housing system of cages of specified dimensions,
- b) Daily cleaning out of cages
- c) A feeding regimen of forage-concentrate-forage
- d) A permanent mating method where the male is kept in the same cage with the females in a family of 4-5 (1 male:3-4 females). The male is then removed as parturition approaches or on sighting an offspring. It is returned immediately after weaning at 28-30 days post-partum, regardless of the litter size or size of the doe.

Data Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) and Analysis of Variance (ANOVA).

Table I: Gestation Length of Grasscutters

FARM	Gestation Length (Days)
A	157.6 ± 3.3 ^a
B	157.5 ± 2.63 ^a
C	156.7 ± 2.36 ^a
D	156.3 ± 1.95 ^a
E	156.2 ± 1.47 ^a
F	156.9 ± 2.64 ^a
G	157.1 ± 2.18 ^a
Mean	156.61
S.D	1.0195

NB: Values with the same superscript did not show any significant difference ($p > 0.05$).

Table II: Litter Size

Farm	Litter Size
A	4.2 ± 1.23 ^c
B	4.6 ± 1.65 ^c
C	3.4 ± 1.43 ^d
D	3.1 ± 1.20 ^d
E	7.0 ± 1.9 ^a
F	5.2 ± 2.0 ^b
G	3.1 ± 1.60 ^d
Mean	4.59
S.D	0.96

NB: Values with the same superscript do not show a significant difference while those with different superscript represent a disparity ($p < 0.05$).

Table III: Sex Ratio

Farm	Litter Size
A	1.46 ± 0.50 : 1 ^c
B	1.50 ± 0.58 : 1 ^c
C	1.19 ± 0.53 : 1 ^d
D	1.69 ± 0.70 : 1 ^d
E	1.87 ± 1.76 : 1 ^e
F	1.37 ± 0.42 : 1 ^b
G	1.36 ± 0.69 : 1 ^b
Mean	1.45
S.D	0.46

NB: Values with the same superscript do not show any significant difference, those of differing superscript show a disparity ($p > 0.05$).

Table IV: Age at Weaning of Grasscutters

FARM	Weaning Age (Days)
A	28.4 ± 0.84
B	28.8 ± 1.40
C	28.0 ± 0
D	28.0 ± 0
E	28.75 ± 0.87
F	29.4 ± 1.65
G	29.2 ± 1.93
Mean	28.56
S.D	0.38

NB: values with the same superscript do not show any significant difference ($p > 0.05$).

Table V: Birth Weight and Weaning Weights of Grasscutter Litters

	Birth weight (g)	Weaning weight (g)
Mean	133.5	450.4
S.D	42.312	122.2

Results

Statistical analysis of the results indicated that Farm E recorded the least gestation length of about 152 days, the highest litter size of 7 baby grasscutters and the highest sex ratio of 1.8 females : 1 male as shown in Tables I, II & III respectively, while Farms C and D weaned their litters at about 4 weeks of age as shown in Table IV. The mean birth weight of grasscutters on the seven farms visited was 133.5g, while they were weaned when they had an average weight of about 450g.

Discussion

The mean gestation length for grasscutters as recorded in this study was 155.61 ± 1.02 days, with a range between 156.2 ± 1.47 and 157.6 ± 3.3 days. This result is at variance with the findings of Adjanohoun, (1988) who reported a gestation length of 70 days as well as that of Asibey, (1974a), who put the gestation length at 108 ± 5.3 days. It is however in agreement with the findings of Baptist &

Mensah (1986), who reported a gestation length of 152 ± 2 days), those of Addo, (2002), (gestation length of 156 ± 3 days) as well as those of Hafez, (1970) (gestation length of 152 ± 2.98 days). The gestation length recorded in this study was longer probably due to slow growth rate of fetuses in utero as reported by Ntiamoah-Baidu, (1998). In addition, the permanent mating method practiced by most farmers made the detection of the exact date of mating from farm records difficult.

The mean litter size recorded in this study was 4.6 ± 0.28 , which agrees with the reports of Adjanohoun, (1988) who recorded a litter size of 2-4. However, it is in partial agreement with reports by Asibey (1974b) that grasscutters have a maximum litter size of 4 in the wild and up to 12 in captivity. This study recorded a great disparity in litter size among the farms visited, with a range of between 3.1 ± 1.60 to 7.0 ± 1.9 . This may be attributable to management practices. For instance Farm E which had a high litter size supplemented the grasscutter diets with feed components rich in vitamin E and dietary fibre such as pineapple crowns and corn offals. Adequate nutritional supplementation with vitamin E is necessary for the maintenance of reproduction (Hafez, 1970). Other sources of vitamin E include pawpaw, mango, spinach and flouted pumpkin. Farm E did not adhere strictly to the forage-concentrate-forage feeding regimen practiced on other farms. It was also observed that most of the grasscutters that had larger litters were not mated on attainment of puberty at 5-6 months but were mated later when they were 8-11 months old. In addition, since the grasscutter is an induced ovulator, litter size could also be influenced by the virility of the male.

The mean sex ratio of grasscutter litters was 1.45 ± 0.13 males: 1 female. This finding is at variance with reports by Addo, (2002) who reported a sex ratio of 1 male:1 female as well as those of Adu *et al.*, (1999) who reported a sex ratio of

2.1 males:1 female. Factors which influence the sex ratio of grasscutters are not clearly understood but it is known to be genetically transferred and hence heritable and is usually determined by the male (Hafez, 1970). By simple observation a farmer may therefore be able to tilt the sex ratio of the litters born on his farm.

The mean weaning age recorded in this study was 28.56 ± 0.38 days which is at variance with the 6-8 weeks (42-56 days) prescribed in some texts. It was observed that weaning at 28 days had no significant effect on survivability of the litter whatsoever. This may be because grasscutters begin to feed on their own as from 5 days after birth since they are born with their incisors and can therefore be weaned much earlier than 6 weeks. On the other hand, infant grasscutters which overstay with their dam often begin to pull out her hair, causing alopecia and since it is painful, the dam may attack them, and this may result to their death. The mean birth and weaning weights were found to be 133.55 ± 42.32 g and 450.4 ± 122.2 g respectively. This is in agreement with reports by Addo, (2002), who recorded a weaning weight of 370-510g when weaned at 6-8 weeks and a birth weight of 81-145g.

Conclusion

The farming of grasscutter is a potentially lucrative business in which it is possible to produce two litters per annum, if they are weaned at 28 days. It is also possible to achieve an average litter size of 5-7 if an adequate dietary supply of vitamin E is made available. In addition the sex ratio may be positively influenced by observation as it is determined by the male. Grasscutter rearing in captivity is therefore advocated to make its meat available on demand all year round and reduce environmental degradation associated with its collection from the wild. However, intending farmers need to undergo training as grasscutter handling is a skill that needs to be carefully learnt as

they are extremely sensitive animals. Mal-handling may result in inexplicable deaths on the farm as some of them may commit suicide.

This work suggests that with good management practices, particularly early weaning at day 28 post – partum as well as dietary supplementation with feedstuff rich in vitamin E, it is possible to produce two litters of grasscutters in a year. In addition, a larger litter size can be obtained if breeding is delayed slightly for about 1-2 months after puberty. This would increase profitability of the enterprise and make the meat more readily available all year round

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FACTORS INFLUENCING CONCEPTION RATES OF CAMEROONIAN ZEBU CATTLE (*Bos Indicus*) FOLLOWING OESTRUS SYNCHRONISATION AND ARTIFICIAL INSEMINATION

Kamga-Waladjo A R², Tebug S F¹, Keambouc T C³, Ndambid O A, Ndukume J A⁴
and Thiam O⁶

¹Institute of Animal Breeding and Husbandry, Christian-Albrechts-Universität zu Kiel, Olshausenstraße 40, D-24098 Kiel, Germany,

²Ecole Inter-Etats des Sciences et Médecine Vétérinaires, BP 5077, Dakar-Fann, Sénégal

³Faculty of Agronomy and Agricultural Sciences, University of Dschang, P.O.Box 138 Dschang, Cameroon.

⁴FCN Dairy Research Centre at the Department of Agricultural Economics, University of Kiel, Schauenburger Str. 116, 24118 Kiel, Germany

⁵School of Veterinary Medicine and Sciences, University of Ngaoundere, Cameroon.

⁶Soprodel Sarl, BP 18822, Pikine - Dakar, Senegal.

Abstract

A study was carried out to identify and evaluate factors affecting variation in conception rate (CR) in Cameroonian Zebu cattle following oestrus synchronisation and artificial insemination (AI). Two hundred and six local female Zebu cattle were evaluated to determine relationship among lactation number, age, body condition score (BCS), days postpartum and conception rate. Animals received an intravaginal progesterone release device (PRID[®]) containing 1.55mg of progesterone and a capsule with 10mg estradiol benzonate for 10 days and were treated with luteolytic dose of PGF_{2α} and 1000mg IU PMSG at the time of PRID[®] withdrawal. Animals were inseminated 48 hours after PGF_{2α} and PMSG injection. Pregnancy status was assessed by observed non-return to oestrus and confirmed by rectal palpation 55-60 days after insemination. The overall CR was 47.6%. CR was influenced ($p < 0.05$) by lactation number, age and days postpartum of cows. The multivariate logistic regression model used revealed that CR was optimum in primiparous cows, those between 4.5 -7 years old and 151-300 days postpartum.

Keywords: Conception, lactation number, days postpartum, Zebu cattle.

FACTEURS SUSCEPTIBLES DE CRÉER UN IMPACT SUR LES TAUX DE CONCEPTION DES ZÉBUS CAMEROUNAIS (*Bos Indicus*) À LA SUITE DE LA SYNCHRONISATION DES ŒSTRUS ET DE L'INSÉMINATION ARTIFICIELLE

Résumé

Une étude a été réalisée pour identifier et évaluer les facteurs en mesure d'influer sur la modification du taux de conception (TC) chez les zébus camerounais des suites de la synchronisation des œstrus et de l'insémination artificielle (IA). Deux cent six (206) vaches locales de la race de zébus ont été évaluées dans la perspective d'une détermination de la relation qui prévaut entre le nombre de lactations, l'âge, la note d'état corporel, le nombre de jours post-parturition et le taux de conception. Les animaux ont reçu un dispositif intra-vaginal de libération de la progestérone contenant 1,55 mg de progestérone et une capsule contenant 10 mg d'estradiol benzonate pendant 10 jours et ont subi un traitement à base d'une dose de PGF_{2α} lutéolytique et 1000 mg UI de PMSG au moment du retrait du dispositif intra-vaginal de libération de la progestérone. Les vaches

sont inséminées 48 heures après l'injection de PGF_{2α} et de PMSG. L'état de grossesse est confirmé par le non retour à l'œstrus vérifiable à travers les palpitations rectales entre 55 et 60 jours après l'insémination. Le taux de conception global (pour l'ensemble des vaches inséminées) a été de 47,6%. Le taux de conception a été influencé ($p < 0.05$) par le nombre de lactations, l'âge, le nombre de jours post-parturition des vaches. Le modèle de régression logistique qui comporte plusieurs variations utilisé dans le cadre de la présente expérience a confirmé que le taux de conception a été optimal chez les vaches primipares, celles dont l'âge se situe entre 4,5 et 7 ans et comptant entre 151 et 300 jours de post parturition.

Mots clés: Conception, nombre de lactations, jours post-parturition, zébu.

Introduction

Agriculture accounts for as much as 30% of the gross domestic product and about 70% of overall employment in Cameroon. The livestock sector is dominated by ruminants and represents about 30% of revenue of the rural population (DSCN, 2002; FAO, 2003). The national cattle herd is estimated at 6 million and is composed mainly of non-specialised indigenous multipurpose zebu breeds (*Bos indicus*) which are Red Fulani, White Fulani and Gudali (Bayemi *et al.*, 2005; FAOSTAT, 2009)

The Western Highlands covering the West and Northwest regions with its rich grassland fields for forage production is the second agro-ecological regions associated with cattle production in the country (Bayemi *et al.*, 2005). As it is the case in other tropical countries, these cattle are reared essentially under the traditional low input husbandry management system and often subjected to poor nutrition and disease control hence low productivity (Mukasa-Mugerwa, 1989; Abeygunawardena and Dematawewa, 2004; Bishop and Pfeiffer, 2008).

In order to improve the low productivity of these local cattle, selection of the most promising breeds and cross breeding with highly productive exotic cattle is a practical solution. Although, on station trials are being carried out to improve the use of locally produced semen (Bayemi and Mbanya 2007; Bayemi, *et al.*, 2010), AI using imported semen supported by oestrus synchronisation is still the basic method for

improvement of Cameroonian Zebu cattle as is the case in parts of Africa (Mattoni and Ouedraogo, 2000; Abeygunawardena and Dematawewa, 2004; Kamga-Waladjo *et al.*, 2006).

CR has been used as tool for monitoring the reproductive performance of cattle (Mattoni and Ouedraogo, 2000; Voh *et al.*, 2004; Chebel *et al.*, 2004; Grimard *et al.*, 2006; Sá Filho *et al.*, 2009; Escrivão *et al.*, 2009; Santos *et al.*, 2009). Achieving high conception rates is therefore a key requirement for successful AI programme and determines the overall profitability of cattle farm. Decades have past since AI was introduced in Cameroon but few studies have been carried out to evaluate the effectiveness and to improve on the use of this technology on local breeds at field level. Identifying and evaluating factors influencing CR might contribute to improve the efficiency of AI on zebu cattle.

The objectives of the present study were to identify and to evaluate factors associated with conception rates in Cameroonian zebu cattle following oestrus synchronisation and artificial insemination.

Materials and Methods

Farm Location and Management

This study was carried out in a commercial farm during a period of six months in the West Region of Cameroon. This farm lies within the Sudano-Guinean Zone of Cameroon (5°28' N, 10°7'E) with two seasons: a wet season from mid March to mid November and a dry season covering the rest of the year. Rainfall ranges

from 1300 to 3000 mm per annum with an average of 2000 mm. Temperature ranges from 15.5 to 24.5°C with an average of 20°C. Relative humidity ranged from 40 to 97% (Pamo *et al.*, 2004).

Initially, 210 dry female animals were retained for this study but 4 were excluded from the analysis because they lost progesterone releasing intravaginal device (PRID) before AI was carried out. These animals were heifers and cows in the first, second and third lactation, 30 to 360 days postpartum and 3 to 9 years old according to farm records. Calves were weaned between 6 months of age while service bulls were withdrawn 6 months prior to this study. These animals were watered ad libitum and grazed on an average of eight hours in the day under the supervision of herdsmen on communal grazing land composed mainly of *Andropogon gayanus*, *A. pseudapricus*, *Pennisetum pedicellatum*, *Panicum maximum*, *Brachiaria ruziziensis* and *Pterocarpus erinaceus*. Night paddocks as well as mineral salt licks were provided.

The animals were vaccinated against *pasteurelosis*, black quarter and contagious *bovine pleuropneumonia* as recommended by the national *bovine prophylaxis* program for endemic diseases. Ectoparasite control was done by spraying with appropriate acaricide on weekly basis in the rainy season and bi-weekly in the dry season. Expert veterinary attention was also sorted when required.

A day prior to oestrus synchronisation, animals were scored for body condition on a 1-5 scale (1= lean, 5= fat) and classified into three categories (< 2.5, $\geq 2.5 \leq 3.5$ or >3.5) as described by Ferguson *et al.*, (1994).

Oestrus synchronisation and artificial insemination

A week prior to synchronisation of oestrus, the reproductive status of each animal was checked by observing clinical signs as well as palpation of uterine content. 210 selected animals were identified with ear tags. *Oestrus synchronisation* and AI was

carried out by the same operator. Cattle received an intravaginal drug release device (PRID[®]) containing 1.55mg of progesterone and a capsule with 10mg estradiol benzonate (PRID[®], Ceva Santé Animale, France) for 10 days and were treated with luteolytic dose of PGF_{2 α} (Cystrol[®], Gellini 375 μ g) and 1000mg IU of Pregnant Mare Serum Gonadotropin (PMSG, Folligon[®], Intervet, France 1000IU) at the time of PRID[®] withdrawal. Animals were inseminated 48 hours after PGF_{2 α} and PMSG injection irrespective of the presence of heat. Imported deep frozen semen (in liquid nitrogen at -196°C) from progeny tested bulls was used. This semen was sanctioned by the appropriate government authority following national and international norms to have been donated by bull free from infectious diseases. Preliminary pregnancy status of each cow was determined by absence of repeats (or non-returns) 18-24 days after insemination. This was confirmed by rectal palpation of the uterine content 55-60 days after AI.

Statistical analysis

Conception rate was calculated as the proportion of inseminated animals pregnant after rectal palpation. For analysis, the model included lactation number, age, days post partum (using predetermined group boundaries), BCS and breed of cows. After a descriptive analysis was made, the relationship between the categories for each cow factors and CR were tested one by one. Significant variables ($p < 0.05$) were fitted into a multivariate logistic regression model. The Wald test was used to test the significance of the overall effect for variables with more than two categories. Odds ratio (OR) and 95% confidence interval (CI) were generated during the logistic regression.

Descriptive analysis was done using SPSS Software (v.12.0) while logistic regression was evaluated using MINITAB (MINITAB version 15.1, Minitab Inc., State College, PA).

Table 1: Frequency unconditional associations between factors studied in relation to conception rate (CR).

Variable	Level	n	CR % (number cows)	P-Value
Lactation number	0 (Heifers)	28	28.6 (8)	0.00
	I	76	63.2 (48)	
	≥2	102	41.2 (42)	
Age of cows (Years)	<4.5	28	28.6 (8)	0.03
	4.5-7	50	60.0 (30)	
	>7	128	46.9 (60)	
Days Postpartum	0 (Heifers)	28	28.6 (8)	0.00
	30 - 150	76	46.1 (35)	
	151- 300	60	66.7 (40)	
	> 300	42	33.3 (15)	
BCS	< 2.5	86	46.5 (40)	0.94
	2.5 - 3.5	84	47.6 (40)	
	> 3.5	36	50.0 (18)	
Breed of Cows	Gudali	60	53.3 (32)	0.29
	Red Fulani	146	45.2 (66)	

Table 2: Multivariate logistic regression model for CR as affected by lactation number and days postpartum.

Variable	level	Odds Ratio	P-Value	Confidence Interval
Lactation number	0 (Heifers)	I		
	I	4.29	0.00	1.67, 11.0
	≥2	1.75	0.22	0.70, 4.35
Days Postpartum	0 (Heifers)	I		
	30 - 150	2.13	0.10	0.84, 5.44
	151- 300	5.00	0.00	1.88, 13.3
	> 300	1.39	0.53	0.49, 3.91
Age of cows (Years)	<4.5	I		
	4.5-7	3.75	0.01	1.38,10.2
	>7	2.21	0.08	0.91,5,37

Results

In this study, 47.6% (98/206) of all inseminated animals were confirmed pregnant 55-60 days after AI. The frequencies and unconditional associations between factors studied and CR 55-60 days after AI are presented on Table 1. Results of a multivariate logistic regression model for significant relationships between factors studied and CR are presented on Table 2

Discussion

The overall CR 47.6% obtained for Cameroon zebu cattle was lower than the 50 - 69% obtained in similar studies on local zebu cows in Burkina Faso, Nigeria and Guinea Republic (Mattoni and Ouedraogo, 2000; Voh *et al.*, 2004; Kamga-Waladjo *et al.*, 2006). In this study, cows with more than 300 days postpartum and heifers which might not have reached puberty (Sá Filho *et al.*, 2009) were included. This may explain the low CR observed.

This study reveals that CR was

significantly influenced by lactation number, age and days post partum. Higher CR was found in primiparous than in multiparous and nuliparous Cameroonian zebu cows. This agrees with the well known fact that CR decreases with increase in parity (Chebel *et al.*, 2004; Grimard *et al.*, 2006; Sá Filho *et al.*, 2009). Data shows that 24.7% more primiparous cows conceived compared to multiparous and nuliparous cows put together. Primiparous cows were 4.3 and 2.4 times more likely to conceived than multiparous and nuliparous cows respectively. The poorer conception rate found in nuliparous cows is in agreement with observations by Peres *et al.*, (2009). Primiparous cows were younger and their metabolism had not have faced severe stress in previous lactations as the case might have been with cows in multiple lactations. Further, primiparous cows generally have less pronounced negative energy balance and postpartum ovarian function is likely not to be affected by energy deficiencies (Butler, 2003; Butler and Smith, 1989).

The overall difference between the three age groups of cows tended to be statistically significant. Cows below 4 years were 110% and 64% less likely to conceive compared to 4.5-7 years and above 7 years cows. This is in disagreement with observation made in a study on dairy cattle where CR was highest in heifers and decline from younger to older cows (Gwazdauskas *et al.*, 1975). The low sample size among cows below 4 years may have limited effective analysis, but the observed CR suggest that synchronisation and AI was most effective in cows in the age group between 4.5 and 7 years.

Contrary to Bayemi *et al.*, (2007) where first ovulation was observed 55.2 ± 26 days postpartum in an on-station study on zebu cattle in Cameroon, over 20% more cows at 151-300 days postpartum conceived than those 30-150 days post partum in this study. However, our results concurs with the average interval between calving and onset of ovarian activity of 171 days postpartum

observed in Tanzanian Zebu cattle (Matiko *et al.*, 2008).

Conclusion

CR was significantly influenced by lactation number, post partum days and age of cows. Optimum CR was achieved in primiparous cows, those between 4.5 -7 years old and 151-300 days postpartum.

This study identified some factors that influence conception rates in cattle herds in Cameroon. Knowledge of these factors will facilitate the widespread use of biotechnology tools such as bovine artificial insemination. Additionally, it will encourage farmers to develop modern farms as a means of improving their livelihood and to development of cattle farming in Cameroon.

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BEAK AMPUTATION EFFECTS ON PERFORMANCE AND EGG QUALITY CHARACTERISTICS OF NATIVE LAYERS (YACON) CHICKENS

Abiola S S^{*1}, Balogun J S¹, Oduguwa O O¹ and Dipeolu M A²

¹College of Animal Science and Livestock Production

²College of Veterinary Medicine University of Agriculture, PMB 2240, Abeokuta, Ogun State, Nigeria

Abstract

An experiment was conducted to determine the effect of beak amputation on performance and egg quality characteristics of egg-type chickens. A total of 132 native layers (Yacon) chickens were obtained from a commercial hatchery for the study. There were four treatments in which upper and lower beaks were amputated at the age of 13 weeks, using different dimensions. Upper and lower beaks were not amputated in treatment 1 (U₀L₀), 8mm of upper beak was amputated in treatment 2 (U₈L₀), 8mm of upper beak and 3mm of lower beak were amputated in treatment 3 (U₈L₃) while 8mm of upper beak and 6mm of lower beak were amputated in treatment 4 (U₈L₆). Beak amputation depressed body weight gain and feed intake. Birds with intact beak (control) had the highest body weight gain and feed intake values of 9.74 and 86.98g/bird/day, respectively. Results obtained on pecking rate were statistically significant (P<0.05). Expectedly, pecking rate was lower in amputated pullets compared with what obtained in birds with intact beak. Rate of re-growth of upper and lower beaks was slower in treatment 3 compared with other treatments. Most of the parameters measured for egg quality traits were in favour of amputated pullet chicks. However, highest hen-day production of 69.06% was recorded for birds with intact beak while the lowest value of 56.02% was obtained in treatment 4 within the laying period of two months. This management practice had no adverse effect on performance and egg quality characteristics of native layers (Yacon) chickens.

Keywords: Beak amputation; egg-type chickens

CONSEQUENCES DE L'AMPUTATION DU BEC DES POULES PONDEUSES DE RACE AUTOCHTONE (YACON) SUR LEUR RENDEMENT ET SUR LES CARACTERISTIQUES DE LA QUALITE DE LEURS ŒUFS

Résumé

L'objectif de la présente expérience était de déterminer les conséquences découlant de l'amputation du bec des poules pondeuses sur leur rendement et sur les caractéristiques de la qualité de leurs œufs. Dans le cadre de ses travaux de recherche, l'équipe de chercheurs s'est procuré 132 poules pondeuses de race autochtone (Yacon) auprès d'une entreprise d'incubation d'œufs de volaille à des fins commerciales. Le traitement de cette expérience a été éclaté en 4 phases au courant desquelles les mandibules supérieures et inférieures du bec des pondeuses ont été amputées, en fonction des dimensions différentes, à l'âge de 13 semaines. Pour le groupe de traitement no 1 les mandibules supérieures et inférieures des pondeuses n'ont fait l'objet d'aucune amputation (Sup. 0 ; Inf. 0). Pour le groupe de traitement no 2 les pondeuses ont subi une amputation de 8mm de la mandibule supérieure (Sup. 8 ; Inf. 0). Les pondeuses du groupe de traitement no 3, par contre, ont subi une amputation de 8mm de la mandibule supérieure, et de 3mm de la mandibule inférieure (Sup.8 ; Inf.3). Enfin, les amputations des mandibules des pondeuses du groupe de traitement no 4 ont été de l'ordre de 8mm pour la partie supérieure et de 6mm pour la partie inférieure (Sup. 8 ; Inf. 6). L'amputation du bec a eu une répercussion désastreuse sur le gain de poids

*Corresponding author: Email: abiolass@yahoo.com

corporel et l'ingestion alimentaire des pondeuses. Les pondeuses témoins dont le bec a été conservé intact présentent le gain le plus élevé en poids corporel et le volume optimal en matière d'ingestion alimentaire, soit respectivement 9,74 et 86,98g par jour et par volaille. Les résultats obtenus sur leur taux de consommation alimentaire sont très intéressants sur le plan statistique ($P < 0,05$). L'on constate, sans la moindre surprise, que le taux de consommation alimentaire est plus faible chez les pondeuses au bec amputé que chez les poules à bec intact. Le taux de repousse des mandibules supérieure et inférieure du bec a été plus lent chez les pondeuses du groupe de traitement no 3 que chez les pondeuses des autres groupes de traitement. S'agissant des paramètres de détermination de la qualité des œufs, la plupart des critères sur lesquels se sont fondés les chercheurs ont penché en faveur des poulets au bec amputé. Il convient toutefois de signaler que durant la période de ponte de 2 mois pour l'ensemble de la volaille ayant servi à la réalisation de cette expérience, le régime le plus élevé de production journalière par poule qui est de 69,06% a été enregistré chez les pondeuses au bec intact, à l'inverse du régime le plus faible de production journalière, estimé à 56,02%, relevé chez les pondeuse du groupe no 4. Cette pratique de gestion n'a eu aucun effet défavorable sur la performance et les caractéristiques de la qualité des œufs des pondeuses de race autochtone (Yacon).

Mots-clés: Amputation du bec ; poules pondeuses

Introduction

Birds kept in groups may sometimes develop unacceptable level of behavioural traits called vices, such as feather pulling and vent pecking, which may result in cannibalism. The abnormal trait may extend to egg pecking during the laying period. The egg industry claims that beak amputation is needed to decrease aggressive tendencies among birds. Beak amputation is a management practice that has long been employed by poultry farmers to reduce cannibalism and feather pecking particularly for egg strain pullets. It is however a practice that has been severely criticized from animal welfare perspective. Some welfare groups believe the practice should be banned or at least not carried out routinely. The major objection to beak amputation has been the perception that it may induce chronic pain through the formation of traumatic neuromas (bundles of tangled nerve fibres) in the beak stump. Physiological and behavioural observations have provided indirect evidence that beak trimming of chickens causes pain in the stump of the beak that may persist for weeks or even months after the operation (Lee and Craig, 1991; Craig *et al.*, 1992). Beak trimming could reduce feed consumption of laying birds during the growing period and

delay sexual maturity (Andrade and Carson, 1975). Nevertheless, some research studies highlighted the advantages of beak trimming. Improved feed efficiency was observed by Harte-Dennis and Pescatore (1986) when birds were beak trimmed at day one of age. Less feed wastage was recorded for beak trimmed birds (Craig *et al.*, 1992).

The present study was carried out to determine the effects of beak amputation on the performance of egg-type chickens pre-lay and during the laying period. In addition, the study evaluated the economic benefit of beak amputation particularly in native egg-type (Yacon) chickens.

Materials and Methods

Experimental site

The study was conducted at the poultry unit, Teaching and Research Farm of the University. The average ambient temperature was 34.7°C, relative humidity of 80% and 12 hours daylight throughout the year.

Management of Experimental Birds

One hundred and thirty two (132) Yacon growing pullets at the age of 12 weeks were randomly allotted to four treatments. The breed is noted for aggressive tendencies.

Each treatment was replicated 3 times. There were 33 birds per treatment and 11 birds per replicate. The birds were raised on deep litter where the floor pens provided space allowance of 729cm² per bird. Growers mash supplying 14.65% crude protein, 4.13% fat, 6.91% crude fibre, 0.98% calcium, 0.35 phosphorus, 2751.94 kcal/kg Metabolizable Energy and water were provided *ad libitum* through out the growing phase. The birds were dewormed at the age of 14 weeks and vaccinated against Newcastle disease at the age of 16 weeks.

At the age of 16 weeks, layers mash supplying 17% crude protein, 4.44% fat, 4.93% crude fibre, 3.86% calcium, 0.69% available phosphorus, 2569.53 kcal/kg Metabolizable Energy and water were provided *ad libitum* till the age of 25 weeks. Birds were fed twice daily (morning and afternoon) in the growing and laying phases, using cylindrical hanging feeders.

Beak Amputation

The beaks were amputated at the age of 13 weeks in order to avoid delay of sexual maturity and persistent chronic pain in the stump of the beak. The operation was performed in the evening to eliminate excessive bleeding. Battery operated de-beaking machine was used for the operation. The beaks were not amputated in treatment 1 (U₀L₀), 8mm of upper beak was amputated in treatment 2 (U₈L₀), 8mm of upper beak

and 3mm of lower beak were amputated in treatment 3 (U₈L₃) while 8mm of upper beak and 6mm of lower beak were amputated in treatment 4 (U₈L₆). Measurements were taken from the tip of the beak posteriorly. Vitamin K was administered in water two days before and three days after beak amputation.

Parameters Measured

Weight gain and feed intake were determined weekly in the growing phase. Pecking rate was monitored by counting the number of times birds pecked or intimidated others at the introduction of feed and while feeding. Beak re-growth was determined at two weeks intervals using venier calliper with measurements taken from the tip of the beak posteriorly. Egg quality traits were monitored daily. Economic benefit of beak amputation was assessed using the prevailing cost of feed at the time of study to calculate cost of feed consumed. Prevailing market price of eggs was also used to determine revenue from eggs. Net profit was calculated by subtracting expenses incurred from revenue.

Statistical Analysis

Data collected were subjected to analysis of variance (Steel and Torrie, 1980) while differences among means were separated (Duncan, 1995).

Table 1: Effect of beak amputation on performance during pre-laying period

Parameters	TREATMENTS				SEM
	U ₀ L ₀	U ₈ L ₀	U ₈ L ₃	U ₈ L ₆	
Body weight gain (g/bird /day)	9.74	8.90	9.24	9.39	0.28
Feed intake (g/bird/day)	86.98 ^a	76.90 ^c	80.70 ^b	85.76 ^a	1.56

a,b,c Means in the same row with different superscripts differ significantly (P<0.05)

Table 2: Effect of beak amputation on pecking rate.

Parameters	TREATMENTS				SEM
	U ₀ L ₀	U ₈ L ₀	U ₈ L ₃	U ₈ L ₆	
Pecking rate/min. (pre-laying)	3.30 ^a	1.53 ^c	1.17 ^d	2.07 ^b	0.25
Pecking rate/min. (laying period)	2.43 ^a	1.10 ^b	0.86 ^c	1.10 ^b	0.16

a,b,c,d Means in the same row with different superscripts differ significantly (P<0.05)

Table 3: Effect of beak amputation on rate of beak re-growth.

Parameters	TREATMENTS				SEM
	U ₀ L ₀	U ₈ L ₀	U ₈ L ₃	U ₈ L ₆	
Upper beak (mm)	36.69 ^a	32.35 ^b	30.97 ^c	30.76 ^c	0.13
Lower beak (mm)	34.02 ^b	35.06 ^a	32.27 ^c	30.07 ^d	0.19

a,b,c,d Means in the same row with different superscripts differ significantly ($P < 0.05$)

Results and Discussion

Results of performance of birds in the pre-laying period are presented in Table 1. Body weight gain per day of the birds was not significantly different among the four treatments. Birds with intact beaks had the highest body weight gain of 9.74g/bird/day while the lowest value of 8.90g/bird/day was recorded in treatment 2. Reduction in body weight in beak trimmed chickens has been reported (Cunnigham, 1992). Results obtained on feed intake were significantly different ($P < 0.05$) among the four treatments. Compared with the control, beak amputated pullets demonstrated reduced feed intake. Highest daily feed intake value of 86.98g/bird was recorded for birds with intact beak while the lowest daily feed intake value of 76.90g/bird was obtained in treatment 2. Report of reduced feed intake and wastage when pullets were beak trimmed (Craig *et al.*, 1992; Carey, 1990) have been documented. Pain is believed to persist in the stump of the beak for weeks or even months following beak trimming and this could be associated with reduced feed intake (Gentle *et al.*, 1990).

Expectedly beak amputation reduced pecking rate pre-laying and during the laying period as presented in Table 2. However, the highest pecking rate/minute was in treatment 1 and the lowest in treatment 3 both in pre-laying and in the laying period. Time spent pecking by beak trimmed pullets in the cage decreased while time spent standing inactive increased compared with intact pullets (Duncan *et al.*, 1987).

There were significant differences

($P < 0.05$) in the rate of beak re-growth as presented in Table 3. Rate of re-growth of upper and lower beaks was lowest for treatment 4 while it was rapid for treatment 2. Upper beak length for treatment 4 was 30.76mm while that of treatment 2 was 32.35mm. The lower beak length for treatment 4 was 30.07mm compared with 35.06mm in treatment 2. Report of significant differences in beak re-growth was also observed (Kuo *et al.*, 1991). Table IV shows the effect of beak amputation on laying performance and egg quality traits. Pullets in treatment 3 came into lay earlier (145 days) with average body weight of 1.36kg, while those in treatment 2 came into lay much later (154 days) with average body weight of 1.47kg. This is contrary to the findings of Andrade and Carson (1975) that beak trimming is a practice delays sexual maturity. Lower age at first egg means reduced feed cost per egg (Ayorinde *et al.*, 1999). Average egg weight at two months in lay ranged between 52.90-57.53g. Birds in treatment 4 produced the heaviest egg with average weight of 57.53g. Yacon is light breed and this group of birds are noted for laying medium size eggs.

Results obtained for hen day egg production were not significantly different from one another ($P > 0.05$). However, compared with the control, best result of hen day egg production of 64.11% was obtained in treatment 2 while the lowest value of 56.02% was recorded for treatment 4 within the first two months in lay. In a similar experiment, Craig *et al.*, (1992) reported no significant difference among beak trimmed laying hens. Results obtained for Yolk and Albumen % were statistically

Table 4: Effect of beak amputation on laying performance and egg quality traits

Parameters	TREATMENTS				SEM
	U ₀ L ₀	U ₀ L ₁	U ₀ L ₂	U ₀ L ₃	
Age at 1st egg (days)	147.67	154.00	145.67	151.67	26.21
Wt. of 1st egg (g)	42.26	42.23	41.98	42.49	1.76
Body weight at 1st egg (kg)	1.43	1.47	1.36	1.45	2.62
Wt. of egg @ 2 mths in lay (g)	53.73	56.63	52.90	57.53	1.28
Hen-day production (%)	69.06	64.11	62.97	56.02	3.37
Yolk (%)	23.17 ^c	23.50 ^{bc}	25.23 ^{ab}	25.78 ^a	0.40
Albumen (%)	67.24 ^a	67.30 ^a	65.80 ^b	65.54 ^b	0.38
Haugh unit (%)	90.84	90.87	95.65	92.49	3.22
Cracks (%)	0.95 ^c	1.27 ^b	0.93 ^c	1.63 ^a	0.01
Shell thickness (mm)	0.33	0.34	0.34	0.33	0.01

a,b,c Means in the same row with different superscripts differ significantly (P<0.05)

significant (P<0.05). However, there was positive correlation between egg weight and yolk % . Highest values for egg weight and yolk % were recorded in treatment 4. Values obtained for Haugh unit were generally high and comparable with one another. Although cracked eggs were noticed in all the treatments, results obtained did not show any particular trend, but could be related to the thinner shelled eggs produced by the birds. Smith (2001) indicated that high temperatures particularly in tropical countries cause birds to lay thinner shelled eggs. In a related study, Grizzle *et al.*, (1992) reported that high temperature (32°C) reduced egg shell quality. In the present study shell thickness ranged between 0.33-0.34mm while most studies recommend 0.35mm to be ideal for shell thickness.

Conclusion

In conclusion, beak amputation had no adverse effect on the performance and egg quality traits of native egg-type (Yacon) chickens. This management practice is capable of decreasing pecking rate or cannibalism usually experienced among birds kept in groups particularly on deep litter.

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ETUDE COMPAREE DES CARACTERISTIQUES DE PONTE DE LA POULE CAMEROUNAISE (*Gallus gallus*) ET D'UN LABEL

Fotsa J C¹, Poné Kamdem D¹, Rognon X³, Tixier-Boichard M³, Meffeja², Tchoumboué J⁴, Manjeli Y⁴ and Bordas A³

¹Institute of Agricultural Research for Development, Mankon Research Station, Box. 576 Bamenda, Cameroon

²Centre de Recherche Agricole pour le Développement de Nkolbisson, BP 2123 Yaoundé, Cameroun

³INRA and AgroParisTech, UMRI 1313 GABI, 78350 Jouy-en-Josas, France

⁴Faculty of Agronomy and Agricultural Sciences of University of Dschang, Box. 222 Dschang, Cameroon.

Résumé

Une évaluation des caractéristiques de ponte des poules locales a été menée en station expérimentale au Cameroun, incluant la comparaison au génotype de type label importé de France. Les poules locales représentaient les écotypes du Centre, Sud, et Nord-Ouest/Ouest (NO/OU) tandis que les labels étaient de génotype soit normal (DW*N) soit nain (DW*D). Les principaux résultats montrent que les labels sont plus tardives et plus lourdes à l'entrée en ponte, avec un poids respectivement supérieur de 43%, 46% et 48% à ceux des poules du NO/OU, Centre et Sud, Le gène de nanisme diminue le poids corporel de 20% dans ce génotype label (2083g par rapport à 2604 g). Le poids des œufs des labels est également plus lourd (56g) que ceux des poules locales (46g) mais ces dernières présentent un meilleur rapport poids d'œuf/poids corporel. A 52 semaines d'âge, le nombre d'œufs a été respectivement de 85 (Centre), 100 (Sud), 92 (NO/OU), 76 (DW*N) et 78 (DW*D) correspondant à une intensité de ponte respective de 68% (Sud), 63% (NO/OU), 62% (Centre), 60% (DW*N) et 59% (DW*D). La masse d'œufs moyenne a été de 875g (DW*D), 803g (Sud), 722g (Centre), 687g (NO/OU) et 672g (DW*N). Le meilleur indice de consommation par kg d'œufs a été obtenu chez l'écotype du Sud (2,97). Les consommations résiduelles étaient faibles pour tous les génotypes à l'exception de l'écotype du NO/OU. La proportion moyenne de vitellus a été de 30% chez les poules locales et de 27% pour les labels. Il peut être conclut que les poules locales ont montré une bonne aptitude à la ponte, la plus performante étant l'écotype du Sud. Le croisement de sujets locaux avec les labels devrait être expérimenté pour améliorer le poids d'œuf.

Mots clés : Cameroun, poules locales, poule label, ponte, efficacité alimentaire, qualité de l'œuf

COMPARATIVE STUDY OF LAYING CHARACTERISTICS OF CAMEROON NATIVE (*Gallus gallus*) AND LABEL CHICKENS

Abstracts

Laying performance of local chickens has been evaluated in a testing station in Cameroun, with a comparison to slow-growing label's genotype imported from France. There were three ecotypes of local chickens (Center, South, North-West/West also called NO/OU) and two groups of label hens, either normal (DW*N) or dwarf (DW*D). Label hens matured later, and were heavier than local ecotypes by 43%, 46%, and 48% as compared to NO/OU, Center, and South ecotypes, respectively. The dwarf gene decreased body weight of label hens by 20% (2083g versus 2604 g). Body weight of local ecotypes ranged from 1,362g (Center) to 1,481g (NO/OU). Egg weight was

Corresponding author: fotsajc2002@yahoo.fr;

also higher for label hens (56g) than for local hens (46g) but the egg weight/body weight ratio was higher for local hens. At 52 weeks of age, egg number reached 85 (Center), 100 (South), 92 (NO/OU), 76 (DW*N) et 78 (DW*DW) and corresponding laying intensity was 68% (South), 63% (NO/OU), 62% (Center), 60% (DW*N) et 59% (DW*DW). Average egg mass recorded between 32 and 36 weeks of hens' age were 875g (DW*DW), 803g (South), 722g (Center), 687g (NO/OU), and 672g (DW*N). The best food conversion ratio was obtained with local South ecotype (2.97). Residual feed intake was low for genotypes except for the NO/OU. The mean yolk percentage reached 30% in local hens as compared to label ones (27%). It could be concluded that, indigenous hens revealed a rather good laying ability in the controlled conditions of the testing station, the best performance being exhibited by the South ecotype. Crossbreeding between local ecotypes and label genotypes should be tested to improve egg weight.

Key words: Cameroon, local chickens, label chickens, laying performance, food efficiency, egg quality.

Introduction

Les poules locales constituent environ 70% des volailles en milieu rural camerounais où elles sont élevées par des paysans dotés de peu de moyens (RGA-Cameroun, 1984 ; INS-Cameroun, 2001 ; Teleu Ngandeu et Ngatchou, 2006). Les souches sélectionnées et les autres espèces de volailles dites non conventionnelles représentent respectivement 24% et 6% des effectifs élevés en milieu rural (Fotsa et al., 2007b). En raison de leur faible niveau de production, les poules locales n'offrent qu'une faible contribution au produit national brut malgré leur effectif important estimé à plus de 35 millions (Poné Kamdem, 1998; INS-Cameroun, 2001). Les contraintes inhérentes à ce faible niveau de production ont déjà été identifiées (Fotsa et al., 2007a,b). Des enquêtes de terrain au Cameroun ont montré une production annuelle d'environ 51 œufs en milieu rural (Fotsa et al., 2010a). La modification du système d'élevage a permis d'atteindre une production annuelle de 128 œufs chez les poules locales au Nigéria (Oluyemi, 1979; Oluyemi et Roberts, 1979). L'objectif de notre étude a été d'évaluer le potentiel de ponte des populations de poules locales dans des conditions améliorées et de le comparer à celui d'un génotype de type label T431 issu du sélectionneur SASSO. Il s'agit plus spécifiquement d'évaluer l'intensité de ponte, la masse d'œufs produite, la

consommation alimentaire et l'efficacité alimentaire, les composantes de l'œuf et la mortalité des pondeuses. A terme, l'objectif est de mettre en place un programme d'amélioration génétique qui permettra d'obtenir des sujets plus productifs dans des conditions améliorées en milieu paysan.

Materiels et Methodes

Matériel animal

Une population parentale de poules locales a été mise en place à partir d'œufs fécondés, collectés dans trois régions (Centre, Sud et Est) de la zone forestière à pluviométrie bimodale du Cameroun ainsi que dans la zone des hauts plateaux du Nord-Ouest et de l'Ouest située en climat camerounien d'altitude. Les œufs ont été collectés dans les villages afin d'obtenir une population représentative du milieu rural. Ils ont été incubés à la station expérimentale de l'Institut de Recherche Agricole pour le Développement (IRAD) de Mankon située dans la région des hauts plateaux du Nord-Ouest du Cameroun. Élevé en claustration jusqu'à la maturité, ce troupeau a été mis en reproduction en constituant des familles par région d'origine avec 1 coq accouplé à 7 ou 8 poules, en évitant autant que possible les accouplements entre les sujets apparentés. De plus, un génotype de type label T431 (issu du croisement entre les coqs T44 et les femelles naines SA31A) du sélectionneur SASSO a été importé de France pour être

contemporain de la population parentale locale. De croissance plus lente que le poulet industriel, ce génotype est sélectionné pour être utilisé en élevage de plein-air ; ses qualités de rusticité suggèrent qu'il puisse s'adapter aux conditions environnementales camerounaises. L'importation de 204 poussins mâles et femelles de génotype T431 a permis de constituer une population parentale 'témoin label'. Les animaux expérimentaux issus de la reproduction des T431 entre eux sont comparables à un croisement de 3ème génération car leurs parents sont déjà issus d'un croisement. De ce fait, ces animaux sont susceptibles d'exprimer une plus grande variation phénotypique que leurs parents.

Pour chaque type génétique, trois cycles de ramassage d'œufs de 14 jours chacun ont été réalisés puis conservés dans une chambre froide maintenue à 18°C. Les œufs ont été incubés tous les 15 jours. Les éclosions successives ont eu lieu les 27 février, 13 et 27 mars 2006 correspondant ainsi aux lots 1, lot 2 et lot 3

Élevage des animaux

A l'éclosion, tous les poussins ont été identifiés par famille de père et par type génétique puis bagués à l'aile gauche et pesés individuellement. Ils ont été élevés au sol sur litière de copeaux de bois pendant six semaines dans un même bâtiment. Chaque écotype a été placé dans un cercle de garde de 4 m² sous deux éleveuses comportant deux lampes à incandescence de 100 Watts chacune, suppléées par un réchaud à pétrole en cas de coupure d'électricité. L'élevage en phase jeune a été fait sans complément lumineux. A cette latitude, la variation du cycle nyctéméral est très faible et la durée de l'éclairage naturel est voisine de 12 heures.

Tous les poussins ont été vaccinés à l'éclosion contre les différentes maladies virales (pseudo peste aviaire, Gumboro, Marek, variole, bronchite infectieuse) puis soumis à un programme vaccinal complet avec des traitements contre

les maladies bactériennes si nécessaire. Avant leur transfert en cages individuelles, les pondeuses ont été soumises à deux traitements antiparasitaires à intervalle de 10 jours.

Les poussins expérimentaux ont été nourris aux différents stades de leur développement avec des aliments achetés dans le commerce comme suit:

- de l'éclosion à la 8ème semaine, ils ont reçu un aliment démarrage 'chair' contenant 21,9 % de protéines brutes, 5,6 % de matières grasses, 3,6 % de cellulose brute et 6,7 % de minéraux;

- de la 9ème semaine à la 19ème semaine, un aliment 'poulette' a été distribué contenant 19,5 % de Protéines Brutes, 6 % de Matières Grasses, 12 % d'Humidité, 4,7 % de Cellulose Brute et 6 % de Minéraux;

- de la 20ème semaine à la 52ème semaine d'âge, un aliment commercial 'ponte' a été distribué ayant les caractéristiques ci-après : 16 % de protéines brutes ; 7,0 % de matières grasses ; 36 % de sucre+amidon ; 4 % de cellulose brute.

Pendant la période d'élevage, les températures minima et maxima relevées ont été respectivement de 20°C et 26°C alors que les valeurs minima et maxima de l'hygrométrie relative ont été respectivement de 62% et de 82%. Un épisode de choléra aviaire a entraîné une forte mortalité, représentant 49% des effectifs entre la 4ème et la 10ème semaine.

Après la mise en cage individuelle, les pondeuses ont été élevées sans complément lumineux et ont reçu une alimentation à volonté.

Constitution des types génétiques en phase adulte

Au cours de cette phase, deux phénotypes ont été observés chez les femelles du génotype témoin label, qui ont été issus de la ségrégation de la mutation du nanisme au locus DW chez les parentaux témoins. En effet, tous les coqs T431 sont hétérozygotes pour cette mutation et ont donné une moitié de femelles normales

(notées DW*N) et une moitié de femelles naines (notées DW*DW).

Le phénotype nain ou normal a été confirmé lors de la mise en cage, et a été pris en compte pour l'analyse des performances dès l'éclosion puisque les poussins ont été identifiés individuellement à cet âge.

Collecte de données

Mortalité

Les mortalités ont été notées dès le transfert des poules en cages individuelles, de la 18^{ème} semaine d'âge jusqu'à la 52^{ème} semaine.

Performances de ponte

L'âge au premier œuf (en jour) a été déterminé à partir de la date de ponte du premier œuf. Chaque poule a été pesée lors du premier œuf. Cependant, ces données sur le premier jour de ponte n'ont pas toujours pu être obtenues, ce qui explique l'effectif inférieur de poules ayant les données du premier œuf par rapport à l'effectif de poules ayant des données pour les autres variables de ponte.

Chaque œuf pondu a été enregistré individuellement et quotidiennement depuis l'entrée en ponte jusqu'à la fin de l'expérience (52^{ème} semaine).

L'intensité de ponte (rapport entre le nombre d'œufs de chaque poule et sa durée de ponte effective) a été calculée à partir de l'âge au premier œuf de chaque poule en ponte.

Caractéristiques de l'œuf

À l'entrée en ponte, les trois premiers œufs ont été pesés pour chaque poule, leur longueur (L) et leur diamètre (D) ont été mesurés en cm avec un pied à coulisse pour le calcul de l'indice de forme ($[(D/L)*100]$). Entre 32 et 36 semaines, trois œufs successifs par poule ont été collectés puis pesés individuellement ainsi que la longueur et le diamètre de chaque œuf ont été mesurés pour le calcul de l'indice de forme. Après ces mesures, chaque œuf a été cassé pour séparer le vitellus du blanc

épais et la pesée du vitellus. Ensuite, les deux portions de la coquille ont été lavées et séchées, avec leurs membranes, à l'étuve à 90°C pendant 12 heures puis pesées à 0.1mg. Les valeurs ont été ensuite arrondies au centigramme. Le poids du blanc a été calculé par différence entre le poids de l'œuf et la somme réunissant le poids de la coquille et le poids du jaune. De ces valeurs ont été déduits les différents rapports exprimés en pourcentage (%): poids du jaune/poids de l'œuf, poids du blanc/poids de l'œuf, et poids du jaune/poids du blanc.

Consommation alimentaire et efficacité alimentaire

L'aliment 'ponte' a été stocké dans des seaux individuels numérotés; chaque poule disposait d'une mangeoire individuelle remplie à partir d'un seau numéroté. L'aliment a été pesé au début et à la fin de chaque semaine en même temps que les refus. Le contrôle a duré quatre semaines, entre 32 et 36 semaines d'âge. La somme des quantités consommées pendant les quatre semaines constitue la consommation totale observée (O) pour chaque poule. Pendant la même période de quatre semaines, tous les œufs de chaque poule ont été pesés pour déterminer la masse d'œufs totale (E). L'indice de consommation individuel a été calculé par le rapport de la consommation observée (O) sur la masse d'œufs (E). Les poules n'ayant pas pondu au moins cinq œufs n'ont pas été prises en compte pour le calcul de cette variable.

Consommation alimentaire résiduelle

La consommation alimentaire résiduelle (R) a été calculée comme la différence entre la consommation totale (O) mesurée de 32 à 36 semaines et la consommation théorique (T). La consommation théorique (T) pour chaque poule a été estimée en fonction de son poids corporel moyen (P), de sa variation de poids entre 32 et 36 semaines d'âge (ΔP) et de sa masse d'œufs (E) à cette période, suivant l'équation de régression multiple

(Byerly, 1941):

$$T = a P_{0,5} + b \Delta P + c E + d$$

Dans le cas présent, l'équation suivante a été obtenue :

$$T = 63,45 P_{0,5} + 0,578 \Delta P + 0,238 E - 136,5.$$

Cette équation expliquait 77,7% de la variance totale de la consommation alimentaire.

La même équation a été utilisée pour tous les types génétiques (poules locales, labels normales ou naines) afin de pouvoir les comparer entre eux.

Analyses statistiques

Tous les caractères de ponte et de consommation ont été étudiés par une analyse de variance portant sur les facteurs Type Génétique (TG) et Lot (L) à l'aide de la procédure GLM du logiciel SAS (SAS, 2001). Quand les effets TG ou L ont été significatifs, la comparaison des moyennes a été ensuite réalisée par un test t appliqué à chaque paire de moyennes estimées par la méthode des moindres carrés, selon l'option PDIFF de la procédure GLM. Les taux de mortalités ont été comparés par le test de Khi-deux (Snedecor et Cochran, 1989).

Resultats

En raison d'un très mauvais taux d'éclosion, le nombre de poules issues de la région de l'Est a été trop faible pour permettre l'étude de ce génotype. Aussi, 5 types génétiques ont finalement été comparés : 3 écotypes Camerounais (Centre, Sud, Nord-Ouest/Ouest (NO/OU)) et 2 témoins de type label (femelles normales, DW*N, ou naines, DW*DW). Les effectifs de poussins par type génétique sont récapitulés au tableau 1.

En raison de la forte mortalité jeune, l'effectif total de pondeuses mises en contrôle a finalement été de 180 poules locales (total pour les 3 régions) et de 171 poules de type label. La mortalité des poules adultes a été faible : elle varie de

Tableau 1: Effectifs des poussins au démarrage par cycle d'incubation (Lot) et par type génétique

Types génétiques	Lot 1	Lot2	Lot3	Total
Centre	114	25	91	230
Sud	173	34	114	321
Nord-Ouest/Ouest (NO/OUU)	88	8	71	167
Labels	277	31	192	500

1,6% pour l'écotype du Sud à 7% pour les poules label, sans que ces différences ne soient significatives (Tableau 2).

Tableau 2: Taux de mortalités (%) chez les femelles adultes (18-52 semaines).

Type génétique	Effectif à 18 semaines	Morts	% mortalités
Centre	56	2	3,57
Sud	62	1	1,61
Nord-Ouest/Ouest	62	4	6,45
Label T431	171	12	7,02
Test de Khi-deux			3,71 NS

NS : $P \geq 0,05$

Performances de ponte

On peut observer en premier lieu que 15 poules label normales n'ont jamais pondu, soit une proportion de 19% des poules label normales mises en cage. Le Tableau 3 montre un effet très significatif ($P=0,001$) du type génétique sur tous les caractères étudiés ; il en est de même pour le facteur 'Lot' à l'exception du nombre d'œufs à 52 semaines d'âge. L'interaction type génétique*lot est significative pour l'intensité de ponte et pour les caractères pondéraux, de façon plus marquée pour le poids corporel ($P=0,0001$) que pour le poids d'œuf ; elle est principalement due aux effectifs réduits du lot 2.

En ce qui concerne la maturité sexuelle et les pesées au 1er œuf, les poules locales ne diffèrent pas entre elles mais diffèrent des poules de type label, qui ont été plus lourdes et dont l'entrée en ponte a été plus tardive, avec un retard variant de 5 à 14 jours selon les types génétiques. L'écart de poids corporel au 1er œuf entre les poules label normales et les écotypes locaux représente de 43% à 48% du témoin label. Entre poules de type label, le génotype nain a un poids corporel plus faible que le génotype normal (-20%), mais montre un poids d'œuf identique. Le rapport du poids d'œuf au poids corporel est donc amélioré par le gène de nanisme. L'écart entre le poids des œufs des poules labels et celui des poules locales est de l'ordre de 11 à 12g à l'entrée en ponte, soit environ 20% du poids d'œuf des poules label normales. Cet écart est toujours observé à la 36ème semaine mais la différence entre le poids des œufs des poules labels et le poids des œufs des poules du NO/OU et du Sud représente environ 9g, alors que la différence s'est maintenue par rapport au poids des œufs de poules du Centre (écart proche de 12g). On constate des différences entre écotypes de poules locales pour le nombre d'œufs à 52 semaines, qui est meilleur pour l'écotype du Sud et moins bon pour l'écotype du Centre, l'écotype du Nord-Ouest/Ouest ayant des performances intermédiaires. Le nombre d'œufs total des poules locales est également meilleur que celui des poules labels, qu'elles soient normales ou naines. Cette différence est cohérente avec une entrée en ponte plus précoce des poules locales, qui ont eu une période de ponte effective plus longue (de 140 à 143 jours) que les poules labels (129 ou 135 jours selon le génotype) pour un arrêt du contrôle au même âge. Malgré une différence de durée de ponte, le nombre d'œufs et l'intensité de ponte ne diffèrent pas significativement entre les poules labels naines et normales. L'écotype du Sud présente la meilleure intensité de ponte entre le 1er œuf et la 52ème semaine, avec une supériorité

Tableau 3: Performances de ponte selon les types génétiques

Variable	Type génétique (TG)						Test de signification							
	N	Cen- tre	N	Sud	N	NO /OU	N	DW *N	N	DW *DW	TG	Lot (L)	TG	*L
Âge au premier œuf (j)	43	224,5 ^b	57	221,5 ^b	41	221,0 ^b	51	235,5 ^a	65	229,0 ^{ab}	***	***	***	NS
Poids corporel au 1er œuf (g)	43	1404 ^c	57	1362 ^c	41	1481 ^c	51	2604 ^a	65	2083 ^b	***	***	***	***
Poids moyen du 1er œuf (g)	43	40,71 ^b	57	41,28 ^b	41	41,78 ^b	51	52,02 ^a	65	53,02 ^a	***	***	***	*
Poids moyen de l'œuf à 36 semaines (g)	52	44,07 ^c	61	45,82 ^b	52	46,97 ^b	51	56,40 ^a	76	55,51 ^a	***	***	***	*
Nombre d'œufs à 52 semaines	53	88,35 ^b	62	99,94 ^a	52	91,68 ^{ab}	63	75,95 ^c	78	77,64 ^c	***	NS	NS	NS
Intensité de ponte du 1er œuf à la 52ème semaine (%)	53	61,57 ^b	62	67,80 ^a	52	62,89 ^{ab}	63	60,03 ^b	78	59,49 ^b	***	***	***	***
Poules n'ayant pas pondu	2		0	0	0	15	00							

NO/OU : Nord-Ouest/Ouest ; DW[#]N : Label normal ; DW[#]DW : Label nain
 N : effectif des types génétiques. La fluctuation des effectifs d'animaux pour les différentes variables à l'entrée en ponte et à la ponte est due aux données manquantes au premier œuf. Le nombre d'œufs à 52 semaines est calculé par poule sur la durée de ponte effective à partir du 1er œuf. a, b, c: sur la même ligne, les valeurs portant les mêmes lettres ne diffèrent pas significativement (P ≥ 0,05). ***: p≤0,0001; **: P<0,05; NS: P≥0,05.

significative par rapport aux deux autres écotypes et aux deux génotypes de poules label.

L'analyse de la courbe de ponte montre que les poules locales (Centre, Nord-Ouest/Ouest, Sud) et la poule label naine ont atteint le pic de ponte à 44 semaines d'âge avec des taux de ponte respectifs de: 66,44%; 67,45% ; 69,99% et 74,48%, malgré une période de couvaison entre 36 et 40 semaines (pour les locales) tandis que la poule label normale a atteint le pic de ponte à 48 semaines avec un taux de ponte de 68,08% (Figure 1).

Pour la Figure 1, voici les données pour la courbe de ponte des poules locales

Taux de ponte par période de 28 jours par type génétique à partir de l'entrée en ponte

Caractéristiques physiques de l'œuf

Les résultats présentés au Tableau 4 détaillent les caractères externes et internes des œufs des cinq types génétiques à 36 semaines d'âge. Tous les caractères étudiés sont très significativement influencés par le facteur 'type génétique' ($P=0,0001$). L'interaction entre lot et type génétique n'est pas significative sauf pour le poids moyen de l'œuf. L'effet du lot n'est significatif que pour le poids moyen de l'œuf et le pourcentage de coquille.

Les poules locales diffèrent entre elles pour le poids moyen de l'œuf à 36 semaines, plus faible pour l'écotype du Centre, et pour l'indice de forme, plus élevé pour l'écotype du Sud. Les poules labels, naines ou normales, ont un indice de forme voisin de celui de l'écotype du Sud mais plus élevé que celui des autres écotypes, les poules label ne diffèrent pas entre elles sur ces caractères.

Les poules locales ne diffèrent pas entre elles pour la composition de l'œuf, avec un pourcentage de vitellus plus élevé et un pourcentage d'albumen plus faible que chez les poules label, naines ou normales, et un pourcentage de coquille plus élevé que chez la poule label normale, mais non

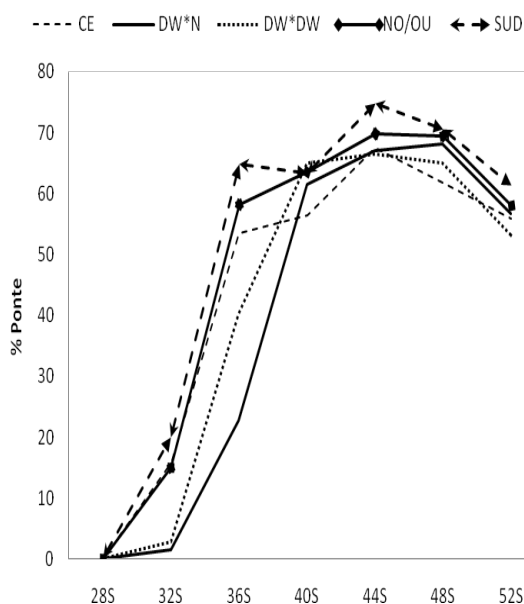


Figure 1: Taux de ponte par type génétique par période de 28 jours depuis l'entrée en ponte.

significativement différent de celui de la poule label naine. Le pourcentage de vitellus le plus faible est observé chez la poule label naine, qui présente également le plus faible rapport vitellus/albumen et se distingue de la poule label normale pour ces deux caractères seulement.

Consommation alimentaire et efficacité alimentaire de 32 à 36 semaines

Les résultats présentés dans le Tableau 5 montrent que tous les caractères étudiés sont significativement influencés ($P=0,0001$) par le type génétique. Par ailleurs, les interactions entre lot et type génétique sont significatives ($P=0,05$) pour le poids corporels des poules, la variation de poids corporel et la consommation résiduelle. La variation de poids corporel pendant le contrôle a été très élevée pour les labels, elle représente de 13 à 15% du poids moyen. Au contraire, les écotypes locaux présentent une variation de poids nettement plus faible que celle des labels et sont assez homogènes entre eux.

La masse d'œufs est plus élevée pour la poule label naine et l'écotype du Sud, elle est plus faible pour la poule label normale et l'écotype du NO/OU, alors que l'écotype du

Écotype	28S	32S	36S	40S	44S	48S	52S
CE	0	15,84	53,44	56,47	67,45	61,73	55,93
DW*N	0	1,53	22,68	61,45	67	68,08	56,63
DW*DW	0	2,84	40,29	64,88	66,44	64,88	53,11
NO/OU	0,134	15,04	58,24	63,67	69,99	69,57	58,1
SUD	0,403	20,04	64,86	63,36	74,88	70,56	61,35

Tableau 4: Composantes des œufs en moyennes

Variable	Types génétiques (TG)					Test de signification		
	Centre N=53	Sud N=61	NO/OU N=52	DW*N N=63	DW*DW N=78	TG (E)	Lot (L)	TG*L
Poids moyen de l'œuf à 36 semaines (g)	44,07 ^c	45,82 ^b	46,97 ^b	56,40 ^a	55,51 ^a	***	***	*
Indice de forme du 1er œuf (%)	74,36 ^b	76,08 ^a	73,72 ^b	76,44 ^a	77,21 ^a	***	NS	NS
Indice de forme de l'œuf à 36 semaines (%)	75,25 ^b	76,69 ^a	74,28 ^b	78,00 ^a	77,90 ^a	***	NS	NS
Moyenne du % de vitellus	30,53 ^a	29,34 ^a	29,74 ^a	27,98 ^b	26,03 ^c	***	NS	NS
Moyenne du % Albumen	57,47 ^b	58,32 ^b	58,41 ^b	61,09 ^a	62,79 ^a	***	NS	NS
Moyenne du % vitellus/Albumen	52,99 ^a	50,65 ^a	51,09 ^a	46,20 ^b	41,24 ^c	***	NS	NS
Moyenne du % de la coquille	11,99 ^a	12,34 ^a	11,85 ^a	10,93 ^b	11,18 ^{ab}	***	***	NS

a, b, c: sur la même ligne, les valeurs portant les mêmes lettres ne diffèrent pas significativement ($P \geq 0,05$).
 ***: $p < 0,0001$; *: $P < 0,05$; NS: $P \geq 0,05$.

Centre présente une valeur intermédiaire. Les poules label ont consommé plus que les poules locales, pour lesquelles l'écotype du NO/OU a consommé plus que les écotypes du Centre et du Sud qui ont les plus faibles valeurs de consommation alimentaire. Il en résulte que l'écotype du Sud a le meilleur indice de consommation de tous les types génétiques, les écotypes du Centre, du NO/OU et la poule label naine ont une performance intermédiaire, alors que la poule label normale a l'indice le plus élevé. Pour la consommation résiduelle, seul l'écotype du NO/OU se distingue des autres par une valeur nettement positive, qui s'explique par une ingestion plus élevée avec une masse d'œufs et une variation de poids corporels plutôt faibles par rapport aux autres types génétiques. Les autres écotypes présentent tous une faible valeur de consommation résiduelle. La poule label normale DW*N présente à la fois une faible valeur de consommation résiduelle et un fort indice de consommation.

Discussion

Comme les performances de ponte du type parental T44 et des femelles croisées T431 n'ont été pas disponibles, il est difficile de comparer les performances de ponte obtenues pour les animaux labels de type F_3 (T431 x T431) à celles habituellement obtenues en France avec 215 œufs à 66 semaines pour la SA31A et un poids corporel de 2350 grammes. Il reste toutefois intéressant de comparer les labels aux poules locales, dans la perspective de futurs scénarios de croisement entre les poules locales et les animaux labels.

La réduction de poids observée avec le gène de nanisme est de même ordre que celle rapportée par Fotsa *et al.* (2010b) en phase adulte mais inférieure à celle rapportée par Mérat (1990). Cette particularité pourrait être la conséquence des différences climatiques et environnementales entre leur milieu d'origine et leur zone d'élevage.

Sur la précocité sexuelle et le

Tableau 5. Consommation alimentaire et efficacité alimentaire de 32 à 36 semaines

Variable	Types génétiques (TG)					Ta été de signification		
	Centre N=48	Sud N=60	NO/OU N=51	DW*N N=42	DW*D N=72	TG (E)	Lot (L)	TG*L
Poids corporel moyen (g)	1328 ^d	1313 ^d	1425 ^c	2420 ^a	1967 ^b	***	***	*
Variation de poids corporel (g)	44,41 ^c	36,62 ^c	7,11 ^c	354,70 ^a	248,72 ^b	***	***	*
Masse totale d'œufs	722,08 ^{ab}	803,38 ^a	686,91 ^b	670,65 ^b	874,60 ^a	*	***	NS
Consommation alimentaire (g)	2284,03 ^d	2259,15 ^d	2410,46 ^c	3340,98 ^a	3057,02 ^b	***	NS	NS
Consommation résiduelle(g)	17,32 ^b	-4,70 ^b	165,92 ^a	-50,26 ^b	11,12 ^b	*	***	***
Indice de consommation (kg aliment / kg d'œufs)	3,51 ^b	2,97 ^c	3,88 ^b	5,90 ^a	3,94 ^b	***	*	NS
Nombre de poules avec moins de 5 œufs	5	1	0	21	6	-	-	-

NO/OU : Nord-Ouest/Ouest ; DW*N : label normal ; DW*D : label nain

l : les calculs ne tiennent pas compte des poules ayant moins de 5 œufs pendant la période de contrôle.

a, b, c, d : sur la même ligne, les valeurs portant les mêmes lettres ne diffèrent pas significativement ($P \geq 0,05$).

***: $p < 0,0001$; *: $P < 0,05$; NS: $P \geq 0,05$

nombre d'œufs, l'absence de différences significatives entre les souches label naines ou normales est cohérente avec les conclusions des travaux antérieurs (Marks, 1981).

L'absence de stimulation photopériodique pourrait expliquer en partie la maturité sexuelle tardive observée dans cet essai par rapport à la précocité rapportée dans la littérature pour différents types de poules locales, avec des valeurs de 23 semaines au Nigéria (Horst, 1997) et au Botswana (Aganga *et al.*, 2003), 24 semaines en Corée (Horst, 1997) et une variation entre 25 et 28 semaines au Sri-Lanka (Gunaratne *et al.*, 1993) et dans les Hauts Plateaux de l'Ouest du Cameroun (Mafeni, 1995). La génération parentale des poules Camerounaises comme des femelles DW*N ou DW*D, élevée en 2005 à la Station expérimentale de Mankon, avait montré aussi une meilleure précocité que la descendance née en 2006 (Fotsa *et al.*, 2007b). Ce retard accusé par tous les types génétiques dans cette étude pourrait aussi être une des conséquences de l'infection par le choléra aviaire subie pendant la phase jeune.

Le poids corporel de poules locales obtenu dans cette étude a été inférieur à celui rapporté sur les hauts plateaux de l'Ouest (Mafeni, 1995) avec une valeur moyenne de 1617 g entre 30 et 36 semaines d'âge tandis que celle de la Dahlem Red (2049 g de poids corporel moyen) a été inférieure à la performance pondérale du label DW*N. De plus, la Dahlem est une souche de type pondeuse à œufs bruns, sélectionnée pour la ponte, alors que les labels sont d'abord sélectionnés sur la conformation et l'homogénéité de la croissance, donc ce sont des génotypes très différents, à croissance différente, et ce ne sont pas des témoins équivalents. Cependant, le poids corporel des poules locales en station est plutôt supérieur à celui observé sur le terrain (Fotsa *et al.*, 2010a) en particulier pour l'écotype du Sud.

La différence de poids moyen de l'œuf en faveur des labels aussi bien naines (DW*D) que normales (DW*N) par rapport aux types génétiques locaux rejoint ce qui a été rapporté dans la zone de Hauts Plateaux de l'Ouest du Cameroun entre la Dahlem Red et les poules locales (Mafeni, 1995). Ce constat a été aussi observé

au Lesotho (Nthimo, 2004) entre des pondeuses à œufs bruns Rhode Island Red et les écotypes du Lesotho et du Nigéria élevés en milieu contrôlé. Cependant, le poids moyen de l'œuf de chaque écotype du Cameroun a été supérieur à celui rapporté en France (Mérat et Bordas, 1982) pour la poule Fayoumi (voisin de 42g quelle que soit la température d'élevage). A la 36ème semaine, les poids des œufs des écotypes locaux étaient inférieurs au poids moyen de 48,63 g précédemment obtenu à l'âge de 34 semaines pour l'écotype des hauts plateaux de l'Ouest du Cameroun (Mafeni, 1995) et supérieurs au poids moyen de 44,5 g observé en milieu contrôlé chez la poule locale du Botswana (Aganga *et al.*, 2003).

Par ailleurs les œufs obtenus dans cette étude sont plus lourds que ceux obtenus en mode divagant chez les poules des régions du Sud (Fotsa *et al.*, 2010a) et que ceux des poules locales de coloris variés ayant des poids d'œufs respectifs de 36,9g à 39,3g en mode d'élevage divagant au Congo-Brazzaville (Bandtaba *et al.*, 2006). On peut donc en déduire un effet favorable du milieu d'élevage en station sur le poids d'œuf.

Enfin, si l'on rapporte le poids de l'œuf au poids corporel, on observe des valeurs plus élevées pour les poules locales (supérieures à 3%) que pour les labels (Mérat, 1990 pour les DW*N et 2,79 pour les DW*DW ; Aganga *et al.*, 2003). Il est cependant proche de celui observé chez des souches ponte spécialisées.

Il existe peu de données sur la ponte des races locales, cependant une intensité de ponte supérieure à 70% a été observée pour la race locale Fayoumi, plus performante que les autres souches égyptiennes, et moins que la Leghorn blanche (Abdellatif, 1984). Notre étude montre que les poules locales ont une meilleure aptitude à la ponte dans les conditions Camerounaises améliorées que les souches croisées de type label. En effet, les objectifs de la sélection des lignées parentales label ont été centrés sur la conformation et la qualité gustative,

par rapport aux poulets de chair standard sélectionnés sur la vitesse de croissance, et peu sur les caractères de ponte. Chez les poules locales, les données obtenues par des enquêtes de terrain (Fotsa *et al.*, 2010a) montrent que les conditions divagantes pratiquées en milieu rural limitent fortement le potentiel de ponte des poules locales par comparaison au niveau de performances atteint par des poules des mêmes régions élevées en station.

Le fort pourcentage de non pondeuses chez les labels (9,62%) est difficile à expliquer en raison de l'apparence identique entre ces femelles et celles pondant normalement. L'existence d'accidents de ponte, avec des pontes internes sans mortalité, ne peut être exclue.

La variation de poids corporel pendant le contrôle alimentaire a été faible chez les poules locales mais élevée chez les poules labels, alors que cette variation était également faible chez la Fayoumi quelle que soit la température d'élevage (Mérat et Bordas, 1982). Il ressort donc que les labels n'avaient pas atteint leur poids adulte à l'âge de 32 semaines, alors que les poules locales avaient atteint un état physiologique stable dans la mesure où les poids à 52 semaines montrent CE (1400g), SU (1400g), NO/O (1500g) DW*N (3000g) et DW*D (2100g). Cette différence peut s'expliquer par une origine génétique très différente, et peut-être par un effet plus marqué de l'épisode de choléra aviaire sur la croissance ultérieure chez les labels.

L'indice de consommation obtenu pour l'écotype du Sud est meilleur que celui obtenu pour la poule Fayoumi en station, qui est voisin de celui de l'écotype du NO/OU obtenu dans cette étude. Les faibles valeurs de la consommation résiduelle observées pour les autres types génétiques à l'exception de celui du NO/OU, ont indiqué une bonne utilisation de l'aliment par rapport aux besoins d'entretien et de production.

La combinaison d'une faible valeur de la consommation résiduelle et d'un fort

indice de consommation chez les DW*N, s'expliquerait par l'utilisation importante de l'aliment pour le gain de poids, qui n'a été pas pris en compte dans le calcul de l'indice de consommation obtenu à partir de la masse d'œufs. Ce phénomène a été plus limité chez la poule naine (DW*DW) en raison d'un poids moyen plus faible.

Pour l'indice de forme des œufs, des valeurs de 75,66% pour la race locale Fayoumi et de 72,46% pour la pondeuse Rhode Island Red ont été rapportées en station (Mérat *et al.*, 1983) ; la valeur trouvée pour la Fayoumi était donc voisine de celles trouvées chez les écotypes locaux du Cameroun et inférieure à celles des labels DW*N et DW*DW dans nos conditions expérimentales, alors que la valeur trouvée pour la Rhode Island Red a été inférieure à celles de notre étude. En outre, chez des animaux croisés (lignée pure de chair et pondeuse à œuf brun) développés pour l'élevage familial en Inde, les indices de formes variant de 76,18 à 78,33 ont été observés en Inde (Niranjan *et al.*, 2008) ; valeurs comparables à celles des labels utilisés dans notre étude mais supérieures à celles des poules locales en dehors de celles des écotypes du Sud. Les différentes valeurs trouvées pour ce caractère montrent qu'il dépend du type génétique.

Les valeurs trouvées pour le pourcentage de vitellus sont inférieures à celles obtenues en France (Mérat *et al.*, 1983) chez les poules Fayoumi et les RIR d'une part, et chez les Fayoumi et des croisements les impliquant en France (Abdellatif, 1984) et au Maroc (Benabdeljelil et Mérat, 1995 ; Benabdeljelil *et al.*, 2003) d'autre part. Cependant, des valeurs plus élevées et proches de celles de la Fayoumi ont été obtenues pour le pourcentage de vitellus chez les poules locales du Nord-Ouest et de l'Ouest (33,18%) au Cameroun (Mafeni, 1995). Un fort pourcentage de vitellus semble être une caractéristique de la poule Fayoumi, qui ne serait pas seulement due à son faible poids d'œuf.

Les poules locales du Cameroun

et les labels utilisées dans cette expérience ont présenté des valeurs de pourcentage de coquille plus élevées que celles rapportées pour la Fayoumi à 41 semaines en France (Abdellatif, 1984) et au Maroc (Benabdeljelil et Mérat, 1995 ; Benabdeljelil *et al.*, 2003) pour les croisements impliquant la Fayoumi et la Mandarrah avec un poids moyen d'œuf variant de 54,5 g à 57,7 g. Au Cameroun, le pourcentage de coquille avait été plus faible, aussi bien pour les poules locales (9,69%) que pour la Dahlem Red (9,25%) à 34 et à 60 semaines d'âge avec des œufs pesant respectivement 48,64g et 60,73g (Mafeni, 1995).

Conclusion

Dans les conditions d'élevage amélioré au Cameroun, les poules locales ont montré une bonne aptitude à la ponte, meilleure que celle des poules de type Label. L'écotype du Sud en particulier montre des performances intéressantes aussi bien sur l'intensité de ponte, le poids de l'œuf que sur l'efficacité alimentaire. On retrouve l'effet favorable du gène de nanisme chez les poules de type chair avec la poule label. On pourrait donc envisager deux types de croisement expérimentaux à tester en station au Cameroun : un croisement entre coqs labels et poules locales de l'écotype Sud d'une part, un croisement entre coqs locaux, l'écotype le plus lourd étant celui du NO/OU et des poules label naines, d'autre part.

Impact

En dépit de la diversité phénotypique et de la préférence des poules de race locale par au moins 80% de la population africaine en générale, leur propriété organoleptique et toutes les autres caractéristiques qui amènent ces populations à ne solliciter que les races indigènes, presque toutes les études montrent qu'elles sont de petites tailles et pondent très peu comparées aux races de référence telles que les souches

sélectionnées pour la ponte et pour la production de la viande. La comparaison de ces deux types génétiques, aux caractéristiques phénotypiques analogues, montre la bonne aptitude des poules locales à la ponte, un meilleur pourcentage de vitellus et un meilleur rapport poids d'œufs/Poids corporel. Chez les labels le gène du nanisme améliore le rapport poids d'œuf/poids corporel. Compte tenu de toutes ces considérations, l'amélioration du poids d'œuf de la poule locale et d'autres caractéristiques génétiques passe par deux types de croisements énoncés en conclusion. Cette stratégie permettra d'avoir des poules locales plus productives pour répondre aux nombreux besoins des populations locales qui en élèvent.

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POTENTIAL FOR USING MULTINUTRIENT BLOCK FOR SUPPLEMENTING FEEDING OF GROWING GOATS DURING DRY SEASON IN CAMEROON

Tendonkeng F¹, Boukila B², and Pamo T E¹

¹University of Dschang, FASA, Department of Animal Sciences, Laboratory of Animal Nutrition, PO Box: 222, Dschang, Cameroon.

²Institut National Supérieur d'Agronomie et de Biotechnologie (INSAB) Université des Sciences Techniques de Masuku. B.P. 941 Masuku, Gabon.

Abstract

The study of the potential for using multinutrient block for supplementing feeding of growing West African dwarf goats during dry season were carried in the Experimental Farm of the University of Dschang. Twenty young West African dwarf goats were divided in two groups of ten animals each 6-7 month old and averagely weighing 9.07 ± 1.17 kg were used. The animals of the supplemented group (group 2) received 100 g of multinutrient block per animal per day whereas those of the control group (group 1) did not receive any supplement. The animals were weight every 14 days for the evaluation of growth. The body condition score (BCS) was take at the beginning and at the end of the study. A sample of 100 g of multinutrient block was taken for the chemical composition analysis. The results showed that the multinutrient block had a high percentage of crude proteins (37.43%DM) and ash (29.03%DM). The organic matter (OM) content, the cells wall constituent (NDF), hemicellulose and cellulose were 70.97; 25.03; 12.40 and 5.70 %DM respectively. At the end of the study, the average BCS (3.9 ± 0.10) and average weight of the supplemented goats (16.90 ± 2.94 kg) was significantly higher ($p < 0.05$) than that of the control group (2.9 ± 0.1 ; 12.42 ± 2.50 kg). The total weight gain was 3.30 kg and 7.89 kg corresponding to a daily average weight gain of 23.57 g/d and 56.35 g/d respectively for the animals of group 1 and group 2. It can be conclude that the multinutrient block significantly improves the growth of the young West African dwarf goats and can be widely used under climate change.

Keywords: multinutrient block, West African dwarf goats, supplement, growth.

POSSIBILITÉS D'UTILISATION, COMME COMPLÉMENTS ALIMENTAIRES, DES MULTI-NUTRIMENTS DANS LA CROISSANCE DES CAPRINS DURANT LA SAISON SÈCHE AU CAMEROUN

Résumé

Les travaux de recherche relatifs à la possibilité d'utiliser, comme compléments alimentaires, des blocs de multi-nutriments dans l'élevage des chèvres Djallonké pendant la saison sèche ont été effectués dans la ferme expérimentale de l'Université de Dschang. Les équipes de recherche ont sélectionné, pour les besoins de cette expérience, 20 chevreaux Djallonké répartis en deux groupes de 10 animaux chacun, âgés de 6 à 7 mois chacun et pesant en moyenne 9.07 ± 1.17 kg. Les animaux du groupe soumis au régime de compléments alimentaires (groupe 2) ont reçu chacun 100 grammes de blocs de multi-nutriments par animal et par jour, à l'opposé de ceux du groupe témoin (groupe 1) qui en sont privés. Les animaux ont été pesés tous les 14 jours en vue de suivre de près l'évolution de leur croissance. Au début et à la fin de chaque expérience, l'on a procédé au prélèvement de la note d'état corporel de chaque chevreau. Un échantillon de 100 grammes de bloc de multi-nutriments servi aux animaux était également analysé aux fins de détermination de sa composition chimique. Les résultats des analyses effectuées ont montré que le bloc de multi-nutriments présentait un pourcentage élevé de protéines brutes, à raison de 37,43% de matières

sèches et de cendres à concurrence de 29,03% de matières sèches. La teneur en matières organiques, les constituants pariétaux, notamment les fibres au détergent neutre, l'hémicellulose et la cellulose ont été de 70,97; 25,03; 12,40 et 5,70 % de matières sèches respectivement. A la fin de l'expérience, la note moyenne d'état corporel ($3,9 \pm 0,10$) et le poids moyen des caprins soumis au régime de compléments alimentaires ($16,90 \pm 2,94$ kg) ont été significativement plus élevés ($p < 0,05$) que ceux du groupe témoin ($2,9 \pm 0,1$; $12,42 \pm 2,50$ kg). Le gain de poids total enregistré a été de 3,30 kg et de 7,89 kg correspondant à une augmentation pondérale quotidienne moyenne de 23,57 grammes par jour et de 56,35 grammes par jour, respectivement pour les animaux du groupe 1 et du groupe 2. Ces données concrètes nous autorisent à conclure que le bloc de multi-nutriments joue un rôle effectif dans la croissance de jeunes caprins Djallonké et que ce cas de réussite mérite d'être adopté et appliqué à grande échelle dans le contexte du changement climatique.

Mots clés: bloc multi-nutriments, Chèvres Djallonké, Compléments alimentaires, croissance/élevage

Introduction

Ruminants form a major component of domesticated livestock in Africa, especially in the Central African region. The climate in this region is characterized by a relatively short dry season that alternates with a much longer rainy season. Typically, ruminants in the region are mainly grazed and/or browsed on available natural pastures. However, the quantity and quality of fodder available from natural pasture has seasonal fluctuation (Pamo *et al.*, 2006; Pamo *et al.*, 2007). During the rainy season, pasture plants grow rapidly and, although their nutritive value may be high at the start of the rainy season, they mature rapidly with a resulting decline in nutritive quality (Lhoste *et al.*, 1993).

During the dry season, there is an acute shortage of feed and available forages are of very poor nutritive quality (i.e., low in crude protein (CP) and high in fibre), which results in low voluntary intake by ruminants and low digestibility. Low pasture quality and limited availability of water is reflected in low production and reproductive performance, as well as slow growth, in ruminants especially when grazing is the main feed (Oteino *et al.*, 1992; Pamo *et al.*, 2001; Pamo *et al.*, 2006; Pamo *et al.*, 2007).

In West Cameroon, goats are raised in extensive systems where they eat a diet composed of tree-leaves and shrubs which is available year around, albeit with a low to

medium nutritional quality. In many studies, it was concluded that goats fed browse require a CP supplement. Sudana and Leng (1986) showed that, to be effective, supplements must continuously provide adequate levels of ammonia N ($\text{NH}_3\text{-N}$) for consistent growth of micro-organisms. By including high concentrations of salt-urea and molasses-urea, rapid supplement intake is suppressed. Feed blocks are considered to be a good supplement for poor quality diets, as they allow a ruminally balanced and synchronized supply of nutrients (i.e. energy, N, minerals and vitamins) to ruminants. In addition, feed block technology involves inexpensive ingredients, such as agro-industrial feed by-products, and manufacturing equipment. However, most studies have been completed with penned animals, which may give results different from field conditions.

The information on the effect of supplementing feed blocks to West African Dwarf goats in soudano-guinean zone is unknown, and so this was the objective of the study.

Materials and Methods

Study area

The study was carried out at the Animal Experimental Farm of Dschang University during the months of November 2003 to March 2004. The area falls within the soudano-guinean zone (latitude $5^{\circ}26'N$, longitude $10^{\circ}26'E$). The annual temperature

Table 1: Proportion, role and main nutrients supplied by feed blocks.

Ingredients	Ingredient mixture (kg) ^a	Role	Main nutrients supplied
Molasses	30		Energy, sulphur
Wheat bran	25	Absorbent agent	Energy, nitrogen, phosphorus
Palm kernel	12	Absorbent agent	Energy, nitrogen
Urea	10	Preservative	Nitrogen
Cement	8	Binder	Mineral
Common Salt	7	Preservative	Sodium
Bone meal	5	Mineral	Mineral
White lime	2	Binder	Calcium
Shell	1	Mineral	Mineral

^aQuantities of ingredients are expressed as percentage of fresh weight of ingredient mixture before water addition

varies between 16 and 27°C while the relative humidity is 40-97%. There are two main seasons: the rainy season (April to October) and the dry season (November to March). The altitude is at 1400 m above sea level while the mean annual rainfall is about 2000 mm (Pamo *et al.*, 2002).

Animals

Twenty West African dwarf goats (WADG) aged between 6-7 months and weighing about 9.07 ± 1.7 kg were used for this experiment. These goats were born at the Animal Experimental Farm of Dschang University. They were housed in pens (5 goats/pen to improved access to block) and dewormed using Ivermectine 1%. After two weeks of adaptation, the animals were divided in two groups: the first group (10 goats) was control and the second (10 goats) was the supplemented group.

Preparation of the multinutrient blocs

The different proportion, role and main nutrients supplied by feed blocks are presented in Table 1. Urea had been included (10 kg of ingredient mixture) as a source of non-protein N and also as a preservative. A total of 23 kg of inorganic compounds were used as binder (i.e. quicklime), preservative (i.e. salt), and mineral supplements (i.e. phosphates and mineral). Consequently, feed blocks had a high CP (37.43% DM) and ash (29.03% DM) content while OM and

NDF content were low (70.97 and 25.03% DM, respectively).

Feeding

The goats were allowed to graze daily on pasture of *Brachiaria ruziziensis* between 9 am and 5 pm. The diet of the first group (9.01 ± 0.94 kg) was supplemented using the multinutrient block. Each animal of the supplemented group received 100 g of multinutrient block at the evening after grazing in the pasture during the 140 days of study. All the block was consumed. The second group (9.12 ± 1.26 kg) received no feed supplementation thus serving as the control.

Data collection

Representative samples comprising an entire plant of *B. ruziziensis* (minus the roots) and the multinutrient block were collected monthly for chemical analysis. Standard methods as described in AOAC (1990) were used for determination of dry matter (DM, method no. 930.15) and ash (method no. 924.05). Crude protein (CP, method no. 984.13) was assayed by the Kjeldahl method, modified by using a solution of boric acid (40 g/l) to receive free ammonia during distillation; a solution of 2 g/l of bromocresol green and 1 g/l of methyl red in ethanol as indicator and a standard acid solution (1N HCl) for titration. The fiber fractions (neutral detergent fiber

(NDFom), acid detergent fiber (ADFom) and sulfuric acid lignin (lignin (as) were analysed according to Van Soest et al. (1991) without sodium sulfite and alpha amylase. Both ADF and NDF were not expressed exclusive of residual ash.

The weight of the goats was recorded every 14 days during 140 days using an electronic balance.

The body condition scores (BCS) were measure at the beginning and at the end of the study on the animals of the control (2.8 ± 0.88) and supplemented group (2.9 ± 0.91).

Statistical analysis

The data on body weight gain of goat and BCS of the control and supplemented group were compared using the Student's t-test at the 95% confidence interval (Steel and Torrie, 1980).

Results

Chemical composition of multinutrient block and forage

The multinutrient block were richer in ash (29.03 %MS) and crude protein (37.43 %MS) than *B. ruziziensis* (12.08 %MS and 11.85 %MS respectively for ash and crude protein). On the other hand, the *B. ruziziensis* was richer in organic matter, and fibre than multinutrient block (Table 2).

Effect of multinutrient block on live weight gain and body condition scores

The weight change of animals with supplementation shows that the weight of animals has increased regularly with time (Figure 1). From the beginning of the trial until 70 days, no significant difference was observed between the weights of animals in the control and supplemented group. On the other hand, from 84th to 140th days, the weight of the animals in the supplemented group was significantly ($p < 0.05$) higher than that of the control group. The logarithmic adjustments of weight give very interesting results as shown by the coefficient of determination (Figure 1). These coefficients of determination indicate that a good proportion of weight variation of animals can be explained by the regression curve.

Table 3 presents the initial weights, final weights, total gains, average daily weight gains and body condition score (BCS) of animals in the control and supplemented group. From this table it is clear that the weight and BCS of animals in the control group was comparable to that of the supplemented at the beginning of the test. On the other hand, at the end of the test, the weight and BCS of supplemented animals was significantly ($p < 0.05$) higher than that of animals in the control group. Supplementation with multinutrient block yielded total gains of 7.89 kg, which

Table 2: Chemical composition of multinutrient block and *B. ruziziensis*.

	Chemical composition	
	Multinutrient block	<i>B. ruziziensis</i>
Dry matter (%)	79.46	91.10
Organic matter (%DM)	70.97	87.92
Ash (%DM)	29.03	7.08
Crude protein (%DM)	37.43	11.85
NDFom (%DM)	25.03	71.71
ADFom (%DM)	12.70	39.00
Lignine-sa (%DM)	7.00	12.38
Hemicellulose (%DM)	12.40	32.70
Cellulose (%DM)	5.70	26.63

NDFom: Neutral detergent fibre organic matter; **ADFom:** Acid detergent fibre organic matter.

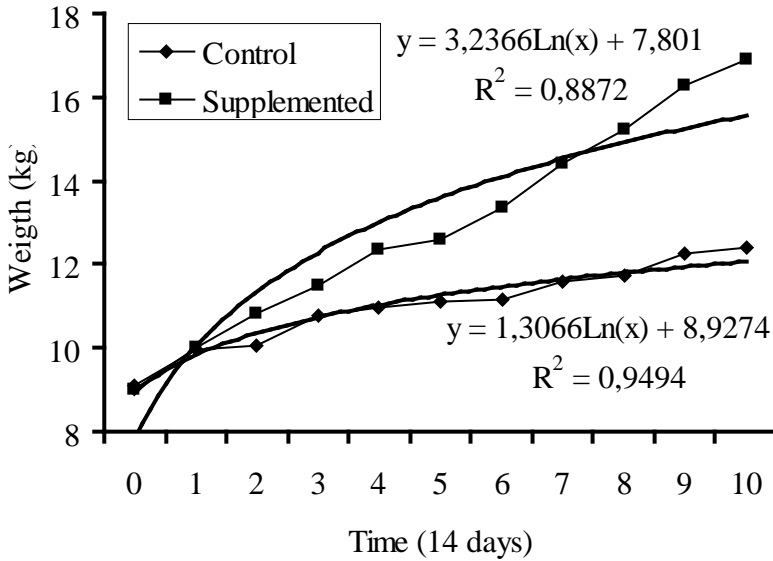


Figure 1: Evolution of the weight of the goats of control and supplemented group.

Table 3: Growth performance of control and supplemented group.

	Groups	
	Control	Supplemented
Initial weight (kg)	9.12±1.26 ^a	9.01±0.94 ^b
Final weight (kg)	12.42±2.50 ^a	16.90±2.94 ^b
Total gain (kg)	3.30	7.89
ADWG (g/d)	23.57±7.3 ^a	56.35±6.37 ^b
Gain over the control	/	58.17%
Initial BCS	2.8±0.88 ^a	2.9±0.91 ^a
Final BCS	2.9±0.12 ^a	3.9±0.10 ^b

corresponds to a daily weight gain of 56.35 g/d over the experimental period (140 days). On the other hand, animals in the control group achieved a total gain of 3.3 kg, corresponding to a daily weight gain of 23.57 g/d. Finally the supplemented animals have achieved an increase weight of about 58.17%.

Discussion

Analysis of the block showed that it has a good chemical composition. These results agree with those found by many authors (Gasmi-Boubaker *et al.*, 2006; El Kirdi *et al.*, 1989; Kunju, 1986, Habib *et*

al., 1994). The positive effect of blocks on poor quality forages intake was reported by several authors (Soetanto and Dixon, 1987; Habib *et al.*, 1994). Complementation with the multinutrient block has significantly improved the growth of West African dwarf goat during the dry season, period during which the forage is of poor quality. These results are in agreement with those found by many authors (Kunju, 1986; Badohu-Nyarko *et al.* 1993; Moujahed *et al.*, 2000). The total gain obtained with animals in the supplemented group (7.89 kg) is higher than that obtained by Badohu-Nyarko *et al.*, (1993) in ewes (6.4 kg). This difference may be explained by the composition of

the blocks, the nature of the basic diet and animal species. The average daily weight gain obtained in this study is very high that obtained by Sudan and Leng (1986) when supplementing the basic diet of sheep made of straw by urea-molasses blocks (10 g/d). This variation in weight can be explained by the nature of crude protein included in the blocks (Soetanto and Dixon, 1987; El Kirdi *et al.*, 1989). The body condition score has been improved significantly in animals of the supplemented group. This observation is in agreement with that found by Boukila *et al.*, (2006). Indeed, in addition to the coverage of maintenance requirements of animals during difficult period, the blocks could potentially allow for higher performance if they contained protein sources of good quality (Moujahed *et al.*, 2003). This type of complementation allows better utilization of forages, especially by improving the fermentation activity in the rumen. Multinutrient blocks supply could also stimulate microbial growth and improve fibre degradation in the rumen due to the catalytic effect of urea, molasses and minerals (Chenost and Kayouli, 1997). Thus, forage intake and digestibility are therefore improved (Moujahed *et al.*, 2003).

Conclusion

Feed supplementation with multinutrient block resulted to an increase in the performance of West African dwarf goat. The supplemented goats gained 58.17% more weight than those of control group during this period (dry season). The average daily weight gain of control and supplemented group was respectively 23.57 ± 7.3 and 56.35 ± 6.37 g/j.

Therefore, there will be a marked improvement in the growth performance when the grazing diet of West African dwarf goat is supplemented with the multinutrient block especially during the dry season.

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COMPOSITION BOTANIQUE DU RÉGIME DES DROMADAIRES ET VALEURS ALIMENTAIRES DES PLANTES INGERÉES SUR UN PARCOURS ARIDE DU NIGER

Chaibou M^{1,*}, Faye B², and Vias G³

¹Faculté d'Agronomie, Université Abdou Moumouni de Niamey BP 10960 Niger

²CIRAD-ES Campus international de Baillarguet 34398 Montpellier Cedex 1 France

³ONG Karkara, BP 510 Niamey, Niger

Résumé

Une étude sur l'alimentation des troupeaux camélins a été menée dans la zone pastorale d'Agadez au Niger. L'objectif de l'étude était de décrire la composition botanique des rations ingerées par les dromadaires sur parcours naturels au cours des trois saisons (saison sèche chaude, saison sèche froide et saison pluvieuse) et de déterminer la composition chimique et les valeurs alimentaires des différentes espèces végétales consommées quotidiennement par les dromadaires afin de savoir ce qu'elles apportent à l'animal qui les consomment en terme d'énergie et de protéines (matières azotées). Six troupeaux de dromadaires ont fait l'objet d'un suivi régulier de septembre 2002 à Août 2003. La méthode de "collecte de berger" (Guerin, 1987) a été utilisée pour étudier la composition botanique du régime alimentaire. Auparavant les parcours ont été étudiés sur le plan de leur composition floristique en utilisant la méthode des points quadrats alignés de Daget et Poissonnet (1971). Vingt espèces herbacées ont été décrites sur les différents sites étudiés avec une prédominance des graminées (58,67%). Le régime du dromadaire comporte, quelle que soit la saison, des herbacées (graminées et autres) et des ligneux. Ces derniers représentant 5%, 44% et 89,5% de ce régime pendant les saisons pluvieuse, sèche froide et sèche chaude respectivement. Aucun résidu de récolte n'est associé à ce régime. L'analyse chimique a montré que les plantes consommées avaient un fort taux des matières minérales. Trois espèces ligneuses présentent des hautes valeurs énergétiques (UFL) à savoir *Boscia senegalensis* (0,81 UFL/kg de MS), *Acacia nilotica* (0,91 UFL/kg de MS) et *Acacia erhembergiana* (0,88 UFL/kg de MS). En terme d'apport en matière azotée digestible (MAD) ce sont *Salvadora persica* (159g MAD/kg MS), *Maerua crassifolia* (148gMAD/kg MS) et *Boscia senegalensis* (213gMAD/kg MS) qui se sont distinguées. Les ligneux sont donc les principaux pourvoyeurs des éléments nutritifs (protéines et énergie) dans l'alimentation des dromadaires dans cette zone en particulier en saison sèche chaude et saison sèche froide car elles représentent respectivement 89,5% et 44% des espèces consommées quotidiennement par les dromadaires.

Mots-clés: valeur alimentaire, composition floristique, régime alimentaire, dromadaire, Niger

BOTANICAL COMPOSITION OF FEED OF CAMELS AND NUTRITIVE VALUE OF CONSUMED PLANTS IN A ARID RANGELAND OF NIGER

Abstract

A study on the feeding of camel herds was carried in the pastoral area of Agadez in Niger. The aim of the study was to describe the botanical composition of daily feed of camels on rangeland during three seasons (hot dry season, cold dry season and rainy season) and to assess the chemical composition and nutritional values of plants consumed by camels to see what is their input of energy and crude protein to the animals. Six herds of camels have been regularly monitored from September 2002 to August 2003. The "collect of shepherd" (Guerin, 1987) was the method used to study the botanical composition of diet. Previously, rangeland were studied in order to know their floristic composition using the method of "quadrat- point" of Daget and Poisson (1971). Twenty

Corresponding author: malamchaibou@yahoo.fr

herbaceous species have been described in three sites with a predominance of gramineae (grass) (58.67%). The diet of camel contain, whatever the season, herbaceous (grasses and others) and ligneous plants. These last represent 5%, 44% and 89.5% of the components of the diet during respectively the rainy season, the dry cold and hot seasons. No crop residue is associated in this diet. Chemical analysis showed that the plants consumed have a high rate of mineral matter. Three plants contained high rate of energy value (UFL), as *Boscia senegalensis* (0.81 UFL / kg DM), *Acacia nilotica* (0.91 UFL / kg DM) and *Acacia erhembergiana* (0.88 UFL / kg DM) . Concerning the digestible crude protein input (DCP) *Salvadora persica* (159 g MAD / kg MS), *Maerua crassifolia* (148 gMAD/kg MS) and *Boscia senegalensis* (213 gMAD/kg MS) were distinguished themselves. So the ligneous plants are the main providers of nutrients (protein and energy) in the diet of camels in this area particularly during dry hot season and dry cold season because they represent respectively 89.5% and 44% of plants consumed each day by camels.

Key-words: food value, floristic composition, diet, dromedary, Niger

Introduction

Les systèmes d'élevage camelins en zones subarides d'Afrique sub-saharienne sont peu connus contrairement à ceux d'Afrique du Nord (Faye, 1997). Le dromadaire est un animal sobre et réputé être adapté aux conditions arides. Ce milieu aride est caractérisé par une pluviosité annuelle inférieure à 150 mm, très mal répartie dans l'espace et le temps (Chaibou, 2005). Sous ces conditions la productivité primaire est très faible dans certains endroits et quasi-inexistante dans d'autres et les ressources alimentaires du bétail sont constituées essentiellement du disponible dans les parcours naturels. Ces ressources, insuffisantes sont en général très dispersées sur des grands étendus. Cette rarefaction des fourrages a façonné non seulement la structure et la composition des troupeaux mais également les pratiques des éleveurs ainsi que le comportement alimentaire des animaux eux même. En tant qu'animal des zones arides et semi-arides, le dromadaire est habitué à la végétation très caractéristique de ces zones. En dépit de certaines observations de Buffon au XVIII^e siècle sur l'alimentation du dromadaire (Faye, 1997), des études menées par Gauthiers-Pilters (1958); (1969), par Kamoun *et al.*, (1989), El Aïch *et al.*, (1992) et par Steinmez (1991) l'alimentation du dromadaire reste aujourd'hui insuffisamment étudiée. C'est pour quoi il a été entrepris à travers cette

étude des investigations sur son alimentation en milieu réel partant de l'hypothèse que cet animal est adapté à vivre dans certains milieux difficiles dépourvus des ressources alimentaires suffisantes grâce à son aptitude à varier sa nourriture. La présente étude effectuée dans le bassin pastoral d'Agadez avait comme objectif de décrire la composition botanique des rations ingerées par les dromadaires sur parcours naturels au cours des trois saisons (saison sèche chaude, saison sèche froide et saison pluvieuse) et de déterminer la composition chimique et les valeurs alimentaires des différentes espèces végétales consommées par les dromadaires afin de savoir ce qu'elles apportent à l'animal qui les consomment en terme d'énergie, et de protéines (matières azotées) en fonction des quantités ingerées.

Matériels et Méthodes

Caractéristiques du milieu d'étude

Les parcours étudiés sont dans un ensemble constituant le bassin périurbain d'Agadez. Ce bassin constitue une zone de déplacements intenses des éleveurs des dromadaires dont certains participent activement à l'économie locale par le ravitaillement entre autre de la ville d'Agadez en lait de chamelle. Le département d'Agadez couvre une superficie de 615 200 km² soit à peu près la moitié de la superficie totale du Niger. La zone proprement dite où l'activité pastorale est très développée est

située entre la 16ème et la 17ème parallèle Nord. Plus au nord une importante partie est occupée par le massif de l'Aïr situé à cheval entre les départements d'Arlit et de Tchirozérine. Il représente une zone de concentration des éleveurs chameliers en particulier en période hivernale. C'est un domaine uniformément plat, dans lequel on peut distinguer deux ensembles écologiques (Figure 1):

- au Nord-ouest, la plaine de Talak, connue sous le nom de Tamesna chez les touaregs de l'ouest. C'est une plaine argileuse.
- au Sud, c'est le domaine de l'Irhazer wan Agadez, « la vallée d'Agadez », zone pastorale par excellence. Cette plaine, immense, forme un arc de cercle qui borde le massif de l'Aïr au sud et au sud-ouest. De nombreux koris qui naissent dans les plateaux se rassemblent à dans le bassin versant à l'ouest pour former l'Irazher qui inonde annuellement la région, y permettant ainsi la poussée de pâturages pendant une bonne partie de l'année (juillet-septembre). Les pâturages de cette zone sont représentés par une végétation steppique, très clairsemée et constituée essentiellement d'arbustes. On rencontre essentiellement des plantes appartenant au genre *Acacia*. Ce sont *Acacia raddiana*, *Acacia ehrembergiana*, *Acacia nilotica* ... D'autres espèces non moins importantes sont présentes comme *Balanites aegyptiaca*, *Boscia senegalensis*, *Maerua crassifolia*, *Calotropis procera* et surtout *Salvadora persica* spécifique à cette zone. La strate herbacée très discontinue est constituée des espèces très appréciées par le dromadaire comme *Aristida mutabilis*, *Tribulus longipetalus*, *Chloris prieurii*, *Lasirius hirsutus* et *Panicum turgidum*. Le substrat de cette zone est constitué d'éléments sablo-rocaillieux et un sol argileux dans les parties dépressionnaires.

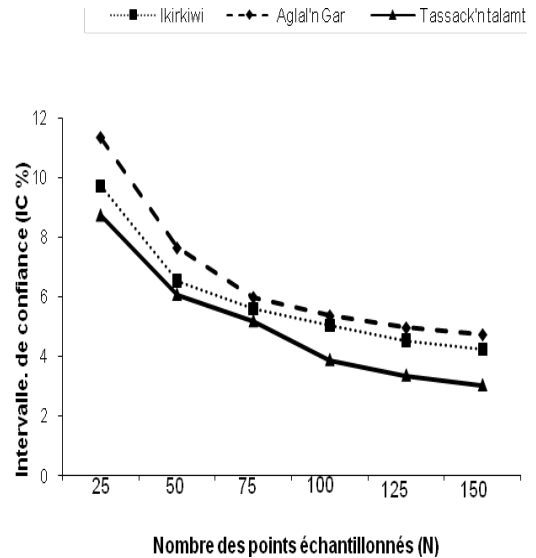


Figure 1: Evolution de l'intervalle de confiance pour l'échantillonnage des points de lecture

Composition floristique des pâturages

La diversité floristique a été étudiée par la méthode des «points quadrats alignés» pour le tapis herbacé (Daget et Poissonet, 1971) et par la méthode du comptage direct pour les ligneux (Ickowicz, 1995).

La méthode des points quadrats consiste à compter le nombre de présences de chaque espèce végétale herbacée à la verticale des points espacés régulièrement (de 20 cm en général en zone sahélienne) le long d'un double-décamètre tendu plusieurs fois au-dessus du tapis herbacé. Une tige effilée (fil de fer solide par exemple) est disposée verticalement à chaque point et permet la lecture des contacts. On dénombre alors les contacts tige effilée-plantes. Chaque espèce végétale ayant des contacts avec la tige n'est comptée qu'une fois au plus par point de lecture. Pour obtenir une précision voulue il a été déterminé le nombre de lignes nécessaires en calculant l'intervalle de confiance (IC) pour la fréquence de l'espèce dominante (Daget et Poissonet, 1971).

La formule de l'intervalle de confiance au risque alpha (α) est :

$$IC = \pm t \quad n * (N-n) / N3$$

N : nombre des points de lecture

n : nombre total de contacts
 t est le t de student pour le risque alpha.

Ces paramètres étant calculés pour chaque espèce:

Les paramètres suivants ont été également calculés:

La fréquence spécifique (F_{si}) qui est le nombre de points de lecture où cette espèce a été enregistrée au cours du relevé. La fréquence centésimale (F_c) qui est le nombre de présences pour cent points d'observation. C'est le rapport entre la fréquence spécifique et le nombre de points de lecture échantillonnés (N). L'intervalle de confiance (IC) a permis de déterminer le nombre de points à échantillonner au niveau du site d'étude. Le calcul a été effectué à partir de l'effectif cumulé ligne par ligne des contacts de l'espèce dominante (n) sur l'effectif cumulé des tous les contacts enregistrés pour l'ensemble des espèces (N). Les mesures ont été effectuées au niveau des trois sites différents. Il s'agit des sites de Ikkirkiwi, Aglaln'gar et Tassackn'talam. L'étude de la diversité floristique des ligneux a été réalisée sur deux sites à savoir Ikkirkiwi et Tassackn'talam par défaut de moyens logistiques. Les mesures réalisées sur quatre stations délimitées dont chacune de 100 m x 100 m, ont permis de décrire les principales espèces ligneuses présentes dans cette zone et de mesurer les différents paramètres physiques (surfaces recouvertes par le houppier au sol) des individus présents dans la station. L'importance de l'espèce a été appréciée soit par sa contribution relative à la population globale du site, soit par son recouvrement à travers la mesure des diamètres des houppiers des arbres (Ickowicz, 1995). En raisons d'intérêts que la biomasse fourragère présente pour la population animale, il a été jugé utile d'estimer plutôt le recouvrement au sol qui traduit quelque part l'abondance du houppier fourragère de l'arbre.

Composition du régime alimentaire

Cette étude a été menée de septembre 2003 à août 2004. La méthode de base choisie pour étudier la composition alimentaire du régime était " la collecte de berger "(Guerin, 1987). Elle a permis d'évaluer l'importance relative (en %) des différentes espèces fourragères entrant dans le régime alimentaire des dromadaires exploitant les pâturage naturels. Cette méthode a pour but de constituer des échantillons proches du régime des animaux tant au plan d'espèces que d'organes consommés. La collecte du berger fait appel en général à un ou deux observateurs pour la récolte des informations. L'observateur suit pendant 30 secondes la prise alimentaire de l'animal et prélève aussitôt lui aussi, au même endroit, une poignée du végétal consommé par l'animal imitant ainsi les coups de dents de l'animal. Les espèces présentes dans chaque poignée sont identifiées et notées en "présence-absence" (Tezenas, 1994). Cette méthode ressemble à un dénombrement des contacts bouche de l'animal-espèce végétale. Ainsi pendant trois jours consécutifs et tous les deux mois, six troupeaux de dromadaires à la recherche de pâturages étaient suivis sur les parcours. Au cours de ce suivi des animaux, il a été notées sur les fiches d'observation, les espèces consommées, la partie du végétal (feuilles, fruits, fleurs.....) consommée, la strate. La durée (en secondes ou minutes) pendant laquelle une espèce végétale a été consommée a été estimée à partir de la formule suivante (Tezenas, 1994) :

$$C_j = \sum_i^q (C_{i,j}) * q - I$$

Avec $C_{i,j} = N_{i,j} * P_{i-l}$

C_j : pourcentage de consommation de l'espèce j lors d'une journée d'observation;

q : nombre de quarts d'heure d'observation;

$C_{i,j}$: pourcentage de l'activité pâturage d'une

espèce j pendant un quart d'heure i ;

Ni_j effectif d'animaux qui consomment l'espèce j pendant un quart d'heure i ;

Pi effectif des animaux observés en activité pâturage pendant un quart d'heure i.

Ainsi dix huit journées d'observations au cours de la période d'étude ont été effectuées et ont permis d'évaluer la fréquence des espèces dans le prélèvement, de classer les espèces consommées selon leurs familles ethnobotaniques et de voir la tendance du régime selon les saisons. La fréquence de chaque espèce dans un prélèvement, rapportée au nombre total d'observations, a permis de calculer pour un temps donné (T) et selon le type de végétation, la contribution spécifique (C_{si}) par espèce (nombre de présences de cette espèce par rapport au nombre total de présences) et par famille. Il a été également possible de calculer la contribution centésimale (C_{ci}) qui est égale au nombre de présences d'une espèce sur 100 prises alimentaires.

Composition chimique et valeur alimentaire des plantes ingérées

Au cours de la mise en œuvre de cette méthode de collecte, de l'identification des espèces broutées au pâturage par le dromadaire et la détermination de la composition du régime, il a été obtenu une liste quasi exhaustive de toutes les plantes consommées par le dromadaire dans la zone d'étude. Des échantillons de ces plantes ont été prélevés, séchés au soleil, broyés et conservés pour les analyses bromatologiques afin de déterminer leur composition chimique et leurs valeurs alimentaires. La finalité de ces analyses est de préciser la valeur nutritive du régime des dromadaires selon les saisons. Mais les données sur les valeurs alimentaires de certaines plantes tropicales étant disponibles dans la bibliographie notamment Richard (1987), Rivière (1978), El Shami

et Elgenied (1987) Guerin et al., (1989), Richard et al., (1990), Ickowicz (1995), il a été plutôt question d'obtenir des données complémentaires pour les espèces peu étudiées. En revanche pour les espèces nouvelles, toutes les analyses alimentaires ont été effectuées. Chaque échantillon était préparé à partir de la récolte d'un organe (feuilles, fruits, fleurs ou tiges....) dont les observations ont montré leur ingestion par les animaux. Les analyses de ces échantillons ont été conduites au laboratoire de nutrition animale du CIRAD-EMVT (Centre internationale de recherche agronomiques pour le développement, département Elevage et médecine vétérinaire des pays tropicaux), et ont été effectuées selon les méthodes codifiées et décrites par AFNOR (1981) (Association Française de normalisation). Les éléments suivants ont été déterminés:

matières minérales (cendres totales);
matière sèche (MS);
matières azotées totales (par la méthode de Kjeldahl);
cellulose brute de Weende ;
constituants pariétaux par la méthode de Van Soest :

- les parois totales (Neutral Detergent Fiber –NDF)
- la ligno-cellulose (Acid Detergent Fiber-ADF)
- la lignine (Acid Detergent Lignin –ADL)

En complément des analyses chimiques classiques, des analyses de la dégradabilité enzymatique à la solution de pepsine-cellulase ont été effectuées. Ainsi, pour tous les fourrages, les dégradabilités de la matière sèche (dMS) et de la matière organique (dMO) ont été déterminées. Ces dosages étaient nécessaires pour la prévision de la digestibilité de la matière organique et des matières azotées digestibles en utilisant des regressions mises au point par certains auteurs (Guerin et al., 1989). Ces équations de prévisions ont été établies pour les graminées, légumineuses et autres dicotylédones mais également

pour les fourrages ligneux en zones tropicales (Guerin et al., 1989). La valeur de la digestibilité de la matière organique étant estimée, les valeurs UFL (Unité fourragère lait) des fourrages étaient calculées selon les modèles proposés par Guerin et al. (1989) en reliant les caractéristiques chimiques de ces fourrages à la dMO (digestibilité de la matière organique) et les matières azotées digestibles (MAD). Le test statistique non-paramétrique de Mann-Whitney a été utilisé pour comparer les valeurs moyennes des différents critères analytiques (MS, MAT, MAD...).

Résultats

La composition floristique des parcours fréquentés

Sur les trois sites d'étude plusieurs lignes d'échantillonnage étaient nécessaires pour estimer avec suffisamment de précisions la composition floristique des formations herbacées. Le tableau I présente l'évolution des intervalles de confiance au niveau de trois sites en fonction du nombre des points de lecture (Tableau I). Sur le site de Ikirikiwi, et de Aglaln'gar, il a fallu 150 points de lecture pour avoir une précision satisfaisante ($P < 5\%$), alors qu'à Tassack n'talam 100 points de lecture ont permis d'avoir une bonne précision (c'est à dire un intervalle de confiance inférieur à 5%). Les résultats du calcul des paramètres de mesure sont présentés dans le tableau I. Au total 20 espèces différentes appartenant à différentes familles botaniques ont été recensées au niveau des sites d'étude. Le groupe des graminées est le plus représenté dans les trois sites. Ce groupe représente 50% des herbacées à Tassack n'talam, 56% à Ikirikiwi et 70% à Aglaln'gar pour une moyenne globale de 58,7% pour l'ensemble de la zone (Figure 3)

Les contributions spécifiques ont été déterminées pour chaque espèce ce qui a permis d'identifier les espèces dominantes sur chaque site. Sur le site de Ikirikiwi, c'est un pâturage à dominance de *Eragrotis tremula*. Mais des espèces comme

Choenfeldia gracilis et *Shouwia thébaïca*, sont relativement importantes. Sur le site de Aglaln'gar, c'est plutôt *Aristida mutabilis* qui domine suivie de *Eragrotis tremula*. Le site de Tassack n'talam présente un pâturage dominé par le groupe des graminées pérennes avec notamment *Panicum turgidum* et des graminées vivaces comme *Lasirius hirsutus*. Les mesures réalisées sur les quatre stations de 100 m x 100 m, ont permis de décrire les principales espèces ligneuses présentes dans cette zone et d'évaluer les surfaces couvertes au sol par leurs houppiers. Le tableau 2 présente la synthèse des principaux paramètres. Ainsi à Ikirikiwi, *Salvadora persica* représente l'espèce la plus importante car sa contribution au recouvrement totale est de plus de 35,5 %. Vient ensuite, *Acacia raddiana* qui contribue à environ 31,2 % au recouvrement total. Sur les sites de Tassack n'talam, *Acacia erhembergiana* domine en terme de recouvrement (37%) mais également en terme de nombre d'individus (35,5%). *Acacia raddiana* vient en deuxième position pour un recouvrement relatif d'environ 26 %.

Le régime alimentaire du dromadaire

La collecte du berger renseigne sur l'utilisation effective de la végétation par les animaux. Une première analyse de la composition botanique du régime a été réalisée, qui montre l'évolution de ce régime au cours de l'année. Quelle que soit la saison, le régime comporte des plantes ligneuses, des herbacées divers et des graminées. Cependant on peut dire que ce régime est globalement dominé par les plantes ligneuses car il est constitué d'au moins 44% et au plus 90% des plantes ligneuses sur une période de plus de sept mois (saison sèche froide et chaude). Seule la saison pluvieuse offrant un maximum des fourrages herbacées favorise un régime constitué fortement de plantes herbacées principalement les graminées (environ 79%). Sur le plan spécifique, et pour une meilleure discrimination entre les groupes

Table 1 : Répartition (%) des herbacées par groupe par sites étudiés

Sites	Graminées	Légumineuses	Herbacées diverses
Ikirkiwi	56	22	22
Aglal'ngar	70	10	20
Tassack'n talamt	50	14.3	35.7

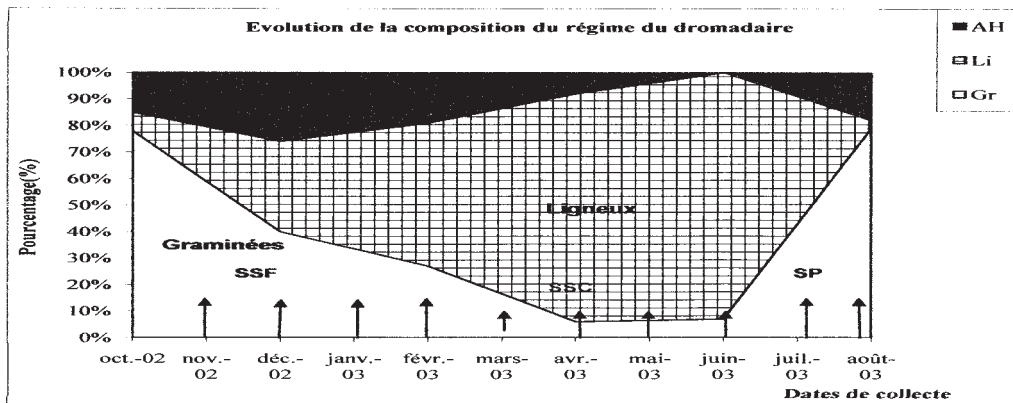


Figure 2 : Evolution de la composition botanique régime du dromadaire au cours de l'année

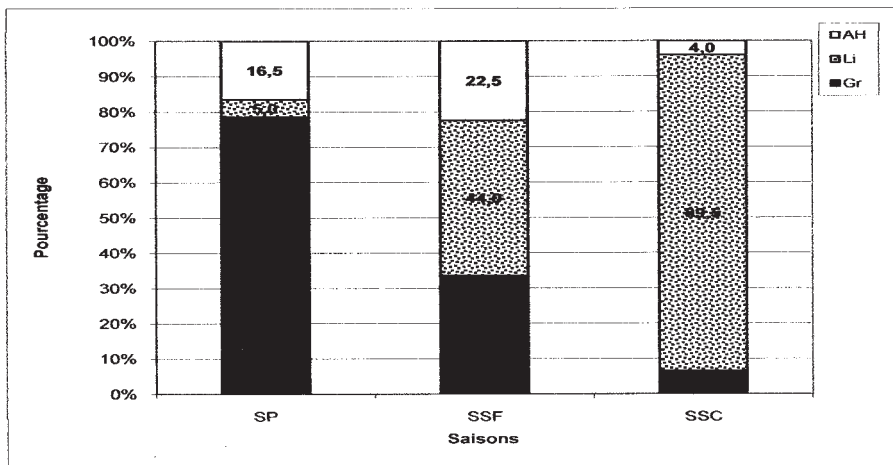


Figure3 : Contribution des groupes végétaux au régime du dromadaire
 AH : autres types d'herbacées Li : ligneux Gr : graminées

Site	Zone	Nbre points de lecture	Nbre contacts	Nbre de lignes placées	IC (%) à 150 points de lecture	Recouvrement(%)
Ikirkiwi	1	150	319	6	4,47	68
Aglaln'gar	2	150	302	6	4,81	53
Tassackn'talam	3	125	328	6	3,94	36

Tableau 2: Proportion des espèces par rapport à la population de la station (%P) et au recouvrement global

Sites	Ikirkiwi		Tassackn' talam	
Population (indiv /ha)	57		45	
Recouvrement (m ² /ha)	563		135	
Espèces	%P	%R	%P	%R
<i>Acacia erhembergiana</i>	-	-	35,55	37,03
<i>Maerua crassifolia</i>	19,31	14,17	8,88	10,80
<i>Boscia senegalensis</i>	33,33	19,18	13,33	4,26
<i>Acacia raddiana</i>	24,56	31,18	24,44	25,88
<i>Balanites aegyptiaca</i>	-	-	6,66	16,96
<i>Salvadora persica</i>	22,80	35,46	-	-
<i>Calotropis procera</i>	-	-	11,13	5,04
Total	100	100	100	100

Tableau 3: Résultats des analyses chimiques, enzymatiques et valeurs nutritives estimées des espèces ligneuses consommées par le dromadaire

Espèces	mois	Organes	MM	MAT	CBW	ADL	SMO	dMO	UFL	MAD	Ca	P
<i>Boscia senegalensis</i>	10	Feuilles	8,10	26,28	19,61	14,69	69,00	68,4	0,81	21,30	0,55	0,14
		Feuilles vertes	12,30	17,10	21,10	-	-	-	-	12,60	1,14	0,07
<i>Acacia raddiana</i>	12	jeunes feuilles	5,91	19,36	24,82	13,36	64,86	64,3	0,75	14,40	0,73	0,26
		jeunes rameaux	6,00	16,20	28,20	-	-	-	0,74	11,70	1,02	0,19
<i>Acacia nilotica</i>	2	feuilles	8,31	15,06	19,94	15,36	69,23	73,4	0,91	10,10	1,32	0,18
		feuilles vertes	7,10	16,70	10,80	-	-	-	-	12,20	1,02	0,18
<i>Maerua crassifolia</i>	9	feuilles	26,68	18,74	10,98	6,57	83,84	72,1	0,68	14,80	4,27	0,09
		feuilles vertes	18,90	22,50	8,40	-	-	-	-	18,00	2,61	0,12
<i>Salvadora persica</i>	11	feuilles vertes	21,47	20,05	11,16	1,49	88,36	73,1	0,73	15,90	5,10	0,13
		jeunes rameaux +feuilles	30,20	16,30	14,80	-	-	-	-	11,80	6,01	0,12
<i>Acacia erhembergiana</i>	2	feuilles	9,16	12,62	10,80	7,74	76,73	74	0,88	8,00	2,35	0,13
<i>Acacia erhembergiana</i>	3	infructescences	15,22	11,50	15,02	15,25	64,99	71,1	0,81	7,40	1,44	0,19

Tableau 4: résultats des analyses chimiques, enzymatiques et valeurs nutritives estimées des espèces herbacées consommées par le dromadaire

Espèces	mois	Organes	MM	MAT	CBW	ADL	SMO	dMO	UFL	MAD	Ca	P
Dactylo- tenium aegyptium	8	plante entière	13,22	11,67	23,54	5,56	56,86	67,8	0,76	7,3	0,81	0,19
	7 à 8	floraison	8,8	9,4	29,4	-	-	-	0,75	4,9	0,56	0,24
Cyperus rotendus	8	plante entière	10,5	10,07	17,10	2,77	56,56	66,1	0,71	5,8	0,67	0,22
	8	floraison	11,2	8,3	25,40	-	-	-	-	3,8	0,64	0,17
Cenchrus biflorus	10	tiges+feuilles	18,23	8,31	29,99	7,09	49,64	57,0	0,56	4,5	0,33	0,15
	10 à 11	fructification	12,6	9,7	32	-	-	-	0,57	5,2	0,50	0,19
Lasirius hirsitus	10	tiges+feuilles	13,38	6,73	36,03	7,65	41,27	51,1	0,51	2,8	0,29	0,11
Tribulus longip- etalus	9	plante entière	29,50	11,44	23,54	5,02	61,53	72,8	0,68	7,7	2,64	0,18
Chloris prieurii	10	tiges+feuilles	9,97	7,36	33,52	7,19	48,89	53,4	0,57	3,3	0,30	0,16
	1	repousses	10,5	8,7	33,3	-	-	-	0,58	4,2	0,25	0,18
Aristida mutabilis	10	plante entière	12,10	5,66	31,41	3,57	49,72	51,7	0,53	1,8	0,39	0,15
	9 à 10	stade floraison	7,40	5,9	36,5	-	-	-	0,53	1,4	0,34	0,14
Ipomea verticilata	10	plante entière	17,11	9,69	19,26	-	50,03	65,4	0,70	5,7	1,80	0,12
Panicum turgidum	11	feuilles +tiges	21,43	7,38	22,24	4,09	55,50	58,1	0,57	3,7	0,68	0,21
	10	feuilles + infruct ^o	7,70	6	35,4	-	-	-	0,57	1,5	0,14	0,70
Carulluma russeliana	9	feuilles	15,97	11,91	25,19	4,79	59,27	68,5	0,75	7,6	1,81	0,16
Chloris pilosa	9	tiges+feuilles	18,31	11,13	20,84	3,81	49,11	68,9	0,74	7,0	0,57	0,30
	9	plante entière	10,50	8,2	33,2	-	-	-	0,58	3,7	0,30	0,15
Chleome africana	8	feuilles	22,92	14,33	19,33	3,72	-	83,6	0,9	10,1	4,29	0,26
Schouwia thébaica	12	feuilles	22,37	9,59	15,23	1,43	89,85	68,3	0,70	5,8	2,99	0,33
Pancum latum	10	feuilles +tiges	19,26	5,62	-	-	-	66,6	0,72	2,0	-	-
	10	fructification	12,00	3,9	-	-	-	-	0,58	0	0,28	0,11
Eragrotis tremula	9	feuilles+tiges	13,80	11,33	25,08	3,23	50,76	66,3	0,73	7,0	0,56	0,21
	9	Stade fructifi- cation	4,70	6,9	34,5	-	-	-	0,65	2,4	0,26	0,19
Aristida ad- scensionis	10	plante entière	15,66	5,36	28,21	3,67	44,16	52,5	0,52	1,7	0,33	0,17
	11	Stade fructifi- cation	9,6	5,2	39,5	-	-	-	0,38	0,7	0,25	0,11

Légendes:

MM: Matières minérales

MAT: Matières azotées totales

CBW: Cellulose brute de Weende

ADL: Acide détergent lignine

SMO: Solubilité de la matière organique (dégradabilité enzymatique de la matière organique)

dMO: digestibilité de la matière organique

MAD: Matière azotée digestible

UFL: Unité fourragère lait

Ca: Calcium

P: Phosphore

* MM, MAT, CBW, ADL, Ca, P et MAD exprimées en % de MS et SMO en % de MO

* dMO exprimée en % de MS

* Dans les tableaux 3 et 4 les valeurs soulignées sont des valeurs extraites des tables de R. Rivière (1978)

* UFL et MAD sont calculées à partir des équations établies par Guérin et al. en 1989

Légende complémentaire de la figure 4 :

Principales espèces fourragères du régime.	
P. tur	<i>Panicum turgidum</i>
M. cr.	<i>Maerua crassifolia</i>
I. ver.	<i>Ipomea verticilata</i>
S. p.	<i>Salvadora persica</i>
P. lat.	<i>Panicum latum</i>
S. t.	<i>Schouwia thébaïca</i>
T. long.	<i>Tribulus longipetalus</i>
A. ad.	<i>Aristida adscensionis</i>
C. bi.	<i>Cenchrus biflorus</i>
C. af.	<i>Chleome africana</i>
L. h.	<i>Lasirius hirsitus</i>
D. ae.	<i>Dactyloctenium aegyptium</i>
C. rot.	<i>Cyperus rotendus</i>
C. pr.	<i>Chloris prieurii</i>
C. p.	<i>Chloris pilosa</i>
E. tr.	<i>Eragrotis tremula</i>
A. m.	<i>Aristida mutabilis</i>
A. er.	<i>Acacia ehrenbergiana</i>
A. n.	<i>Acacia nilotica</i>
B. s.	<i>Boscia senegalensis</i>

végétaux, il a été calculé le taux moyen de contribution au régime de chaque espèce végétale pâturée sur les trois périodes de l'étude (Figure 3). La figure 4 indique que les plantes ligneuses qui contribuent au mieux dans le régime, en particulier en saison sèche, sont *Salvadora persica*, *Maerua crassifolia* et *Acacia raddiana*. En saison sèche froide c'est plutôt *Salvadora persica*,

Maerua crassifolia et *Shouwia thebaica* qui domine dans le régime. Par contre en saison pluvieuse les plantes herbacées dominant fortement avec *Aristida mutabilis*, *Lasirius hisitus* et *Eragrotis tremula* (Figure 3). Toutes les espèces consommées par le dromadaire ont été prélevées séparément au cours de la collecte de berger en vue de déterminer leurs valeurs alimentaires au

laboratoire.

Valeur alimentaire des plantes consommées

Les analyses réalisées au laboratoire ont permis d'avoir une idée sur les critères analytiques des principales espèces d'intérêt fourrager, dont les observations sur le terrain ont montré qu'elles sont effectivement consommées par les dromadaires. Les tableaux 3 et 4 présentent les résultats des analyses effectuées complétés avec les valeurs énergétiques (UFL) et azotées (MAD) calculées sur la base des équations établies pour les fourrages ligneux et herbacées du Sahel sénégalais (Guerin *et al.*, 1989). La valeur UFL est évaluée grâce à des équations de prévisions pour l'énergie brute (EB) et la digestibilité de l'énergie (Richard *et al.*, 1990). Quant à la valeur en MAD (Matière azotée digestible), elle a été estimée à partir d'une équation établie pour les fourrages du Sahel sénégalais à partir d'essais expérimentaux en station (Guerin *et al.*, 1989). En absence des données de digestibilité *in vivo* sur le dromadaire permettant de déterminer expérimentalement la dMO (qui traduit la qualité énergétique d'un fourrage) et de calculer les MAD, il a été considéré les modèles trouvés dans la littérature, établis par Guerin *et al.*, (1989), dans le cadre d'une étude au Sénégal, modèles qui ont permis d'estimer ces paramètres dans cette étude et dont les résultats sont présentés dans les tableaux 3 et 4.

Discussion

La composition floristique en fin de saison des pluies dépend étroitement de la quantité des précipitations et de leur répartition dans le temps et l'espace. Si la vitesse de germination joue un rôle essentiel pour l'établissement des espèces (Ickowicz, 1995), elle est insuffisante pour l'expliquer entièrement. Le cortège floristique déterminé dans les trois sites est assez important. Cependant il y a plus d'espèces à Tassackn'talam (14 espèces),

qu'à Ikkirkiwi (9 espèces) et Aglaln'gar (10 espèces). En terme d'espèces recherchées par le dromadaire, les graminées à eux seuls occupent la première place (39,5%). Cependant au point de vue biologique les graminées à germination lente sont celles qui dominent en général sur tous les sites. En effet les herbacés à germination rapide ont tendance à flétrir très tôt quelques semaines après les premières pluies utiles et par la suite elles se font rares vers la fin de saison des pluies, période à laquelle les relevés ont été effectués (Ickowicz, 1995). L'installation des espèces dépend de plusieurs paramètres notamment l'aptitude à la germination, la rapidité de la germination, la résistance au stress et la rapidité de développement des organes végétatifs (Tezenas, 1994). Pour ce qui est des ligneux, *Salvadora persica* représente l'espèce la plus importante à Ikkirkiwi, sa contribution au recouvrement totale est d'environ 35,5%. Vient ensuite *Acacia raddiana* qui contribue à 31,2% au recouvrement total. En terme du nombre d'individus présents, *Boscia senegalensis* occupe la place de choix (33,3%) mais elle ne représente que 19,2% du recouvrement total. En effet cette espèce se présente sous la forme d'individus très rabougris, de petite taille parfois sans feuilles et qui n'apportent rien en recouvrement. Sur le site de Tassackn'talam, *Acacia erhembergiana* est l'espèce la plus répandue avec un recouvrement très important. Elle contribue à hauteur de 37%. *Acacia raddiana* vient en deuxième position pour un recouvrement d'environ 26%. Il a été trouvé dans le Sahel tchadien un recouvrement maximal de 21,5% pour *Boscia senegalensis*, 35% pour *Salvadora persica*, qui sont des espèces bien consommées par les dromadaires (Ickowicz, 1995). Plus une espèce a un recouvrement important, plus la probabilité est grande pour que l'animal rencontre cette espèce et la consomme selon son appétibilité (Steinmez, 1991). Toutefois un recouvrement important de houppier n'est pas forcément proportionnel à l'importance de la biomasse foliaire disponible et

accessible pour le dromadaire, d'où l'intérêt d'évaluer ces deux paramètres pour pouvoir caractériser la production globale offerte par les pâturages ligneux. Celle-ci serait liée à la densité des individus à l'hectare mais également à leur productivité foliaire, paramètres très variables selon les zones. Cependant, quelles que soient la disponibilité et l'accessibilité des fourrages, le comportement alimentaire de l'animal représente une donnée importante et influence le plus souvent l'exploitation et la valorisation de ces ressources.

La composition du régime a été étudiée par la méthode de « collecte de berger » utilisée au Sénégal par Guerin *et al.*, (1986). L'intérêt de cette méthode réside dans sa mise en œuvre aisée, car adaptée pour les études de l'alimentation des animaux élevés en système extensif. Elle a été l'objet de vérifications quant à la précision des résultats obtenus et à leur corrélation avec d'autres paramètres caractérisant le régime des ruminants (Ickowicz, 1995). Dans le cas de cette étude il est apparu la prépondérance des graminées dans le régime du dromadaire en saison des pluies et en début de saison froide. Cela va de soit car en ces périodes les ressources de bonne qualité disponibles sont dominées par le tapis herbacée, bien établi et riche en graminées (70%). La contribution des ligneux dans le régime des dromadaires n'est pas de moindre en particulier en saison sèche. Le pic de consommation des ligneux a été observé en saison sèche chaude, précisément aux mois de mai et juin comme le montre la figure 3. Les ligneux représentent presque 90% de la ration journalière. Les graminées consommées (4% du régime) à cette période sont représentées par les graminées pérennes essentiellement *Panicum turgidum* et les graminées vivaces comme *Lasirius hirsutus*. Les autres herbacées sont représentés par *Schouwia thebaica* plante vivace de la famille des brassicaceae. Cependant même pendant la saison des pluies, période où le tapis herbacé est présent, les ligneux ont été

toujours consommés à hauteur de 5% dans le régime. En saison sèche froide, les plantes ligneuses représentaient en moyenne 44 % du régime du dromadaire dans cette zone. La méthode de collecte de berger permet donc de reconstituer le régime alimentaire d'un troupeau en activité de pâturage sur un parcours extensif donné. Elle se révèle comme une méthode pragmatique qui convient bien lorsqu'il s'agit d'étudier des animaux exploitant les parcours naturels (Guerin *et al.*, 1986). Cependant cette méthode ne permet pas d'estimer les quantités ingérées. Si la description des régimes et de ses variations peut être envisagée par cette méthode, l'évaluation des quantités consommées devra être recherchée par d'autres méthodes comme "la collecte des fèces" ou l'utilisation des marqueurs comme "l'oxyde de chrome ou le dioxyde de titane", ceci évidemment en station. L'étude de la quantité de matière sèche ingérée (MSI) par les animaux sur parcours n'a pas en effet bien été abordée par les scientifiques en raison de nombreuses difficultés qu'elle soulève.

Les plantes herbacées analysées contiennent en effet beaucoup plus de matières minérales comparées aux valeurs de référence lues dans la table de Rivière (1978). Les matières azotées totales (MAT) sont également en proportion plus importantes dans nos échantillons que ceux provenant de la table sauf pour *Cenchrus biflorus*, *Chloris prierii* et *Aristida mutabilis*. La forte proportion des matières minérales totales (MMT) comparativement aux valeurs de la table seraient probablement liées au type de substrat supportant ces plantes. Ce substrat est en effet très riche en sels, expliquant d'ailleurs la pratique courante de la "cure salée" dans ces régions. Mais cette teneur pourrait être due également à une contamination par du sable lors des manipulations de conditionnement des échantillons ou par présence naturelle d'une forte quantité de silice de constitution. Ces plantes peuvent naturellement comporter d'autres types de minéraux essentiels pour

le bétail comme le chlore, le sodium, ou le potassium en raison du type de substrat qui les supporte. Les échantillons des plantes ont été en général récoltés en début du mois d'octobre lorsque s'installait la saison sèche. A cette période la teneur en azote des plantes herbacées en particulier les graminées chute. Pour les autres valeurs, en particulier énergétiques, elles sont très proches ou mêmes égales aux valeurs de la table de Rivière (1978). Au niveau des plantes ligneuses les valeurs des matières minérales totales de la table de Rivière (1978) sont en revanche plus élevées que celles des échantillons analysés à l'exception des valeurs de *Acacia nilotica* et *Maerua crassifolia*. En revanche les valeurs des matières azotées totales (MAT) des plantes récoltées seraient plus importantes que celles de la table de Rivière (1978) sauf pour les deux plantes précitées. Le test statistique de comparaison de Mann-Whitney réalisé sur les valeurs des paramètres analytiques MAT, CBW, MAD, UFL... indique que la différence de valeurs entre les échantillons des ligneux n'est pas significative ($P < 0,05$). Il en est de même pour les herbacées sur les critères MAT, CBW, UFL, MAD, Ca et P ($P < 0,05$). Mais le test de Mann-Whitney sur les valeurs des matières minérales totales aussi bien pour les ligneux que pour les herbacées montre une différence significative ($P < 0,05$). L'examen des écarts types par rapport à la moyenne et la variance des valeurs de nos échantillons sur les critères analytiques utilisés dans cette comparaison (MM, MAT, CBW, UFL, MAD, Ca, P) a montré une grande dispersion des valeurs, principalement pour les matières minérales totales (MM) et secondairement pour la cellulose brute de Weende (CBW).

Conclusion

Ce milieu présente une diversité floristique moyenne. Une vingtaine d'espèces herbacées et sept espèces ligneuses ont été inventoriées. Dans le cortège des herbacées, les graminées représentaient 50%, 56% et

70% respectivement au niveau des sites de Tassackn'talam, Ikirkiwi et Aglaln' gar. Parmi ces espèces on note la présence permanente de *Panicum turgidum* et *Lasirius hirsutus*. En ce qui concerne les ligneux, le recouvrement était plus important à Ikirkiwi avec 563 m²/ha pour un nombre moins important d'espèces présentes. *Boscia senegalensis* était plus importante en nombre mais *Salvadora persica* représentait 35,5% du recouvrement. Dans le 2^e site c'est *Acacia erhembergiana*, qui dominait en nombre (35,5%) et en recouvrement (37%). Cette étude a montré que le régime du dromadaire était constitué sur la base du disponible fourrager sur les parcours. Il était particulièrement diversifié en saison sèche froide et en saison des pluies avec des espèces herbacées variées mais également des espèces ligneuses. Les dromadaires consommaient presque toutes les espèces herbacées du parcours. Mais les graminées représentent environ 78,5% du régime en saison des pluies. Ils participent à 39,5% en moyenne au régime alimentaire au cours de l'année. Les dromadaires s'intéressent particulièrement à certaines espèces comme *Shouwia thebaica*, *Eragrostis tremula*, *Choenfeldia gracilis*, *Aristida mutabilis*, *Citrilus colocynthis*, *Cornulaca monocantha*, *Panicum turgidum* et *Lasirius hirsutus*. Pour les espèces ligneuses en revanche, elles sont toutes appréciées à l'exception de *Calotropis procera*. Ce sont justement ces ligneux qui composent le régime du dromadaire à 89,5 % pendant la saison sèche chaude. Concernant la composition chimique et la valeur nutritive des plantes consommées par le dromadaire, certaines sont très riches en éléments nutritifs (UFL et MAD). C'est le cas de *Dactyloctenium aegyptium* et de *Carulluma russeliana*. Les ligneux les plus riches sont *Boscia senegalensis*, *Acacia nilotica* et *Acacia erhembergiana* (feuilles) pour l'énergie (UFL). Alors que pour l'azote digestible (MAD) ce sont principalement *Salvadora persica*, *Maerua crassifolia* et *Boscia senegalensis* qui se distinguaient. L'efficacité dans la valorisation des parcours

de ce type à travers un comportement alimentaire tout aussi spécifique permet au dromadaire de se constituer une bonne ration qui lui permet de faire face aux exigences biologiques et nutritionnelles de l'organisme.

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Impact

Dans cette zone d'Agadez au Niger on trouve d'importants troupeaux de dromadaires. Dans cet espace aux maigres ressources alimentaires pour le bétail, les éleveurs ne distribuent guère des compléments alimentaires aux animaux. Malgré ces conditions le dromadaire arrive à se constituer, à partir du disponible, un régime moyennement satisfaisant avec un maximum d'herbes en saison des pluies et une prédominance des plantes ligneuses mais associées à des graminées perennes en saison sèche. C'est pourquoi le dromadaire peut constituer un animal de référence en matière d'élevage pour des zones à conditions écologiques difficiles, très défavorisées sur le plan des ressources alimentaires naturelles.

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SHORT COMMUNICATION

SEROLOGICAL SURVEY OF NEWCASTLE DISEASE STATUS IN VILLAGE CHICKEN IN THE BAMENDA HIGHLANDS OF CAMEROON.

*Nfi A N¹, Ekue F N², Pone D K¹, Mafeni J M³, Nji-Mbua Colette¹, Tih Shiffe¹

¹IRAD Mankon Station, P. O. Box 125, Mankon - Bamenda, Cameroon.

²IRAD Nkolbisson, Yaounde, Cameroon.

³IRAD Centre, Ekona, Cameroon.

Rural chicken production is one of the most important activities at every households in the Bamenda Highlands and Cameroon as a whole (Ekue *et al.*, 2002). However, one of the major constraints to the full development of this village chicken continues to be Newcastle disease (ND) (Agbede *et al.*, 1992). In fact, circulating strains of Newcastle disease virus easily decimate all unprotected flocks. Hence village chicken farmers lose large numbers of their birds to Newcastle disease morbidities that occur every year. To appreciate the importance of ND in rural poultry, serological tests are essential to determine the prevalence of the disease in unvaccinated flocks and verify their response to vaccination.

Kits for the detection of antibodies against the Newcastle disease virus (NDV) using enzyme – linked immunosorbent assays (ELISA) are available commercially. The Animal Production Unit of the FAO/IAEA Biotechnology laboratory has designed diagnostic kits, which are robust enough to withstand temperature fluctuations and transit delays in tropical countries. This study describes the serological survey of the ND status of village chickens using one of these kits for the detection of bovine antibodies against Brucella to detect chicken antibodies against NDV based on the prototype kit first described by Bell *et al.*, (1991).

The study area comprised two zones situated one in the high altitude cold area Santa and the other in a low altitude warm area Ndop. In each zone two sets of birds: vaccinated and unvaccinated groups

were identified with wing or leg tags.

The identified birds were vaccinated by eye drop method (Anon, 1991) using the locally available freeze dried ND vaccine. Calibration of the eye dropper was done to know the exact dose rate per bird according to Alders and Spradbrow (2001) following formula:

$$\text{Volume of diluent (ml)} = \frac{\text{Number of doses of vaccine/vial.}}{\text{Number of drops formed/ml.}}$$

Blood samples were collected by venu-puncture of the wing vein either the brachial, ulnar or cutaneous ulnar that runs between the biceps and triceps muscles (Alders and Spradbrow, 2001). These were kept in well identified syringes before transportation for subsequent processing.

Blood collected in the syringes was stored at room temperature with the syringes in slanting positions, with needle ends pointing upwards having created an air space between the blood and the end of the syringe. When coagulation took place and the clot retracted, the required volume of paired sera samples were harvested by careful aspiration with plastic teats, identified and stored at – 20° C until time for use. Samples with suspended cells were centrifuged at 1000 to 1200G for 10 minutes before sera samples were harvested. This was done for both groups at 3, 4, 5, 6 and 8 weeks post vaccination and start of experiment.

The NDV antigen supplied in lyophilised form was a whole virus

*Correspondence address: unitanfi2000@yahoo.co.uk

preparation of LaSota strain purified by sucrose gradient centrifugation. The kit identification is FAO/IAEA NDV/00/08/438, the bench protocol version ND11.00 1.01 (August, 2000).

The NDV antibody kit consisted of Control sera:

- C ++, antibody strong positive;
- C+, antibody moderate positive;
- C-, antibody negative;
- Cc, conjugate control.

All control sera were whole chicken sera freeze dried and stored at + 4° C. A simple indirect ELISA technique was used to screen 1200 sera samples from both the vaccinated (750) and unvaccinated

(450) flocks of village birds against NDV antibodies. These were screened in comparison with the standard control sera that were supplied. The screening for each sera sample was done in duplicate per plate as presented in Tables 1 and 2.

Absorbance was measured in an ELISA reader with filter of 405 nanometres (nm). The results are expressed as percentage positive by calculating the absorbance value of the test samples as a percentage of the value given by the positive control according to formula below:

$$\% \text{ positive} = \frac{\text{Replicate OD values of test serum} \times 100}{\text{Median OD value of C++ control}}$$

Where OD = optical density,
C++ = strong positive control serum

Table 1: Procedure of Indirect ELISA for anti-NDV Antibodies.

ASSAY		CONDITIONS			
Assay steps		Incubation time	Incubation temperature	Plate shaking	Wash step
1.	Coat NDV Ag	Overnight	+ 4° C	No	3 times
2.	Add Test Sera	30 minutes	+37° C	Yes	3 times
3.	Add conjugate	30 minutes	+37° C	Yes	3 times
4.	Add substrate & chromogen	15 minutes	+37° C	Yes	-
5.	Add stopper	None	Room Temp	Tap to mix	-
6.	Read reaction	405 nm filter must be in plate reader			

Table 2: Indirect ELISA Plate Layout.

Wells	Controls				Serum	Samples	in duplicates					
	1	2	3	4			5	6	7	8	9	10
A	Cc	Cc	1	5	9	13	17	21	25	29	33	37
B	Cc	Cc	1	5	9	13	17	21	25	29	33	37
C	C++	C++	2	6	10	14	18	22	26	30	34	38
D	C++	C++	2	6	10	14	18	22	26	30	34	38
E	C+	C+	3	7	11	15	19	23	27	31	35	39
F	C+	C+	3	7	11	15	19	23	27	31	35	39
G	C-	C-	4	8	12	16	20	24	28	32	36	40
H	C-	C-	4	8	12	16	20	24	28	32	36	40

Note: Cc: Conjugate control with no serum; C++ Strong positive serum control; C+ Moderate positive serum control; C-Negative serum control.

From the results of this study, 80% of the sera from the vaccinated flocks were positive against NDV antibodies with few doubtful cases. All the test sera from the unvaccinated birds reacted positive against NDV antibodies. The percentage positive value of 100% in unvaccinated flocks of birds indicated the recent case of the disease agreeing with Bell J G *et al.*, (1991), and these are the survivors of the previous epizootic. This reasoning was also confirmed by the farmers who could spot some survivors of the previous year or season disease outbreak. The peak period of positivity was at the start of each season. These results show that from this serological survey the prevalence of ND in the Bamenda Highlands stand at 80% with two peak periods at the start of the dry and rainy seasons.

The percent positive values were directly proportional to the level of antibodies in the test sample. A percentage positive value of 30% indicated the minimum antibody level to resist a challenge by the virulent virus as found in the unvaccinated group, while a percent positive of 100% indicated excellent protection against the virulent virus demonstrated by the vaccinated groups.

One to two weeks post vaccination, all the birds reacted positive to NDV antibodies. After 2 – 6 months of vaccination, the antibodies titre waned consequently the immunity status agreeing with Hanson (1975). Thus, for an effective measure to control ND outbreaks in village fowls it would be imperative to carry out vaccinations and booster doses two months after the initial vaccination.

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SHORT COMMUNICATION**SONDAGE SEROLOGIQUE SUR LES MALADIES TRANSMISES PAR LES TIQUES CHEZ LES BOVINS N'DAMA EN GUINEE**

Barry A M, Keita S.

Direction Nationale des Services Vétérinaires, République de GUINEE (Conakry)
BP 559

Les maladies transmises par les tiques comme la cowdriose, la babésiose, l'anaplasmose, constituent un problème majeur de santé pour les bovins en Afrique (Jongejan *et al.*, 1988, Uilenberg, 1990). La cowdriose est présente au Sénégal et elle est une contrainte dans le développement de la production animale (Guèye *et al.*, 1993). En Gambie les infections à maladie à tique sont observées occasionnellement sur des bovins N'dama (Murray *et al.*, 1981, Kuttler *et al.*, 1988).

Peu de données existent sur les maladies à tiques en Guinée. Des observations faites par « vétérinaires sans frontières » dans la zone éco-pastorale soudano-guinéenne sur des animaux exprimant des signes de fortes fièvres, d'hémoglobinurie, d'ictère, d'anémie, laissent supposer l'existence de cas cliniques de babésiose dans les élevages. Les éleveurs parlent souvent de syndrome « Woula » qui frappe leurs animaux. Ce syndrome semble être un complexe d'hémoparasitoses qui sévit dans certaines zones éco-pastorales. La Guinée compte 7 zones, dont les zones soudano-guinéenne nord et sud ; la zone du Fouta Djallon nord et sud ; la zone de transition forêt-savane ; la Guinée Maritime ; la Guinée Forestière (DNE, 1993). La faune de tiques de Guinée est constituée d'au moins 33 espèces ; l'espèce *Amblyomma variegatum*, connue comme vecteur de la cowdriose et les tiques du genre *Boophilus*, vecteurs des babésioses et de l'anaplasmose, sont les espèces les plus fréquentes sur le gros bétail (Konstantinov *et al.*, 1990). D'autres données ont été fournies

par Tomassone *et al.*, (2004). L'existence des agents étiologiques de ces infections à tiques devient alors probable. Leurs distributions dans les zones éco pastorales de la Guinée ainsi que leurs rôles dans la transmission de ces affections sur le terrain ne semblent pas être connues.

L'objectif de ce sondage est de connaître dans une première étape, les répartitions des affections à tiques dans les différentes zones écopastorales ; dans une seconde étape de mener des enquêtes épidémiologiques plus approfondies sur les maladies à tiques dans ces zones en tenant compte du vecteur, de l'hôte bovin, et de la relation entre ceux-ci et les agents étiologiques des affections à tique dans le but de mettre en place une stratégie de contrôle de ces maladies.

Les sérums qui ont été utilisés pour les différentes analyses sérologiques provenaient de la sérothèque du laboratoire. La méthode d'échantillonnage des animaux pour constituer la sérothèque, les prélèvements des animaux, le conditionnement et la sélection des sérums en vue de chaque analyse ont été déjà décrits par Barry *et al.*, (2008). Pour la mise en évidence des anticorps de *Cowdria ruminantium*, 273 sérums ont fait l'objet d'analyse en utilisant un test Elisa (van Vliet *et al.*, 1995). Un kit Dot Elisa commercialisé par Dr Montenegro-James, Centre Médicale de l'Université de Tulane, U.S.A., a été utilisé pour détecter des anticorps dirigés contre *B. bovis*, *B. bigemina*, *A. marginale* (Montenegro-James *et al.*, 1990, 1992). A cet effet, environ 300 sérums bovins ont été testés à la fois

vis-à-vis des 3 antigènes (*B. bovis*, *B. bigemina*, *A. marginale*).

Les résultats d'analyse de 273

Tableau I: Résultats sérologiques de la distribution de la cowdriose dans différentes zones éco pastorales en Guinée

Zone (Z)	Préfecture	Elisa Cowdriose		
		Positif	Total	%
1	Dinguiraye	3	14	
1	Koubia	0	1	
1	Koundara	5	7	
1	Mali	11	13	
1	Mandiana	1	9	
1	Siguiiri	2	2	
Z1 Total		22	46	0,48
2	Dabola	1	2	
2	Gaoual	4	6	
2	Kankan	0	6	
2	Kouroussa	4	8	
2	Tougué	3	7	
Z2 Total		12	29	0,41
3	Dalaba	10	13	
Z3 Total		10	13	0,77
4	Kindia	0	4	
4	Mamou	3	11	
Z4 Total		3	15	0,20
5	Beyla	20	27	
5	Faranah	21	48	
5	Kerouane	2	2	
5	Kissidougou	0	4	
Z5 Total		43	81	0,53
6	Boffa	1	6	
6	Boke	6	12	
6	Coyah	0	17	
6	Dubreka	3	4	
6	Forecariah	11	44	
6	Telemele	1	4	
Z6 Total		22	87	0,25
7	Gueckedougou	0	2	
Z7 Total		0	2	0
Total		112	273	41%

sérums de bovins ayant fait l'objet d'une recherche des anticorps de Cowdria ruminantium sont présentés dans le tableau I.

Les prévalences des infections à *B. bovis*, *B. bigemina*, *A. marginale* pour l'analyse d'environ 300 sérums de bovins sont présentées dans le tableau II.

Cette étude révèle que les infections à *C. ruminantium*, à *B. bovis*, *B. bigemina* et *A. marginale* sont présentes chez les bovins N'Dama élevés en Guinée.

Pour la cowdriose sa présence s'expliquerait par la présence d'un vecteur potentiel dans la transmission de la maladie *Amblyomma variegatum*. 62,3% des tiques de Guinée appartiennent à cette espèce (Konstantinov *et al.*, 1990). La séroprévalence de la cowdriose observée est proche de celles trouvées au Mozambique et en Gambie qui sont respectivement de 43% et 52% (Asselbergs *et al.*, 1993, Mattioli *et al.*, 2000). Elle est très inférieure à la prévalence de 90% trouvée dans la zone nord-guinéenne du Sénégal ; cela peut être due à la réaction croisée avec le genre *Ehrlichia* *bovis* dans cette zone (Guèye *et al.*, 1993). L'antigène utilisé le MAPI-B pour la mise en évidence de l'infection dans le cadre de cette étude est spécifique à *C. ruminantium* et les réactions croisées sont observées seulement avec *E. canis* et *E. chaffeensis* (van Vliet *et al.*, 1995). Par contre, Tomassone *et al.*, (2005) n'ont pu mettre en évidence par PCR chez les N'Dama en Guinée ni la cowdriose, ni l'anaplasmose (utilisation de RLB « reverse line blot hybridation »).

Pour les infections à *B. bovis*, *B. bigemina* et *A. marginale*, la stabilité endémique n'est présente que dans la zone 4 et pour une espèce *B. bovis*. Toutes les autres zones écopastorales sont classées instables. En effet, on distingue quatre degrés de situations endémiques suivant la séroprévalence : plus de 70% indiquent des situations de stabilité ; de 21 à 70% correspondent à des situations d'instabilité ; de 1 à 20% indiquent des situations où la maladie est minimale ; la situation sans maladie correspond à 0%

Tableau II: Résultats sérologiques de la distribution de la babesiose et de l'anaplasmosse dans différentes zones éco pastorales en Guinée

Zone (Z)	Préfecture	<i>B.bovis</i>			Dot Elisa <i>B.bigemina</i>			<i>A.marginale</i>		
		Positif	Total	%	Positif	Total	%	Positif	Total	%
1	Koubia	8	43		8	43		3	43	
1	Mali	16	42		7	42		1	43	
Z1 Total		24	85	0,28	15	85	0,18	4	86	0,05
2	Gaoual	15	48		5	47		5	47	
2	Tougué	11	14		4	14		3	14	
Z2 Total		26	62	0,42	9	61	0,15	8	61	0,13
3	Dalaba	0	1		0	1		1	1	
3	Labé	9	13		7	13		2	13	
Z3 Total		9	14	0,64	7	14	0,50	3	14	0,21
4	Kindia	29	32		11	31		0	12	
4	Mamou	17	20		11	20		1	20	
Z4 Total		46	52	0,88	22	51	0,43	1	32	0,03
5	Beyla	0	5		0	5		0	5	
Z5 Total		0	5	0	0	5	0	0	5	0
6	Boffa	3	6		0	6		0	5	
6	Boke	36	43		15	44		14	44	
6	Fria	2	3		1	3		0	3	
6	Telemele	22	39		14	39		3	39	
Z6 Total		63	91	0,69	30	92	0,32	17	91	0,19
Total		168	309	0,54	83	308	0,27	33	289	0,11

(De Vos *et al.*, 1983, Norval *et al.*, 1983, Mahoney *et al.*, 1972) . La forte proportion de séropositifs vis-à-vis de l'antigène de *B. bovis* (54%) laisse penser à l'existence des cas cliniques fréquents lors des stress nutritionnel et physiologique ou des maladies intercurrentes chez les bovins indigènes. Cela est confirmé par des observations faites par « vétérinaires sans frontières » en Guinée à Dabola (zone 2) sur le syndrome « Woula » qui semble correspondre aux symptômes cliniques de la babesiose. Ces infections à *Babesia* sont transmises par des tiques du genre *Boophilus*. *B. annulatus* est un bon vecteur de *B. bovis* (Morel, 2000) et existe en Guinée ; cette espèce représente avec *B. geigy* 90% des tiques (Konstantinov *et al.*, 1990). Selon Morel (2000) *B. geigy* n'aurait pas de rôle, ou un rôle réduit dans la trans-

mission de *B. bovis*.

Ces résultats sérologiques mettent en évidence l'existence des infections à tiques en Guinée chez les bovins N'dama en fonction des zones éco-pastorales. L'inventaire de la faune de tiques, l'étude de leur dynamique, l'étude des caractéristiques des enzooties dans les différentes zones doivent être menés dans la perspective de mettre sur pied un plan de prophylaxie stratégique.

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Bulletin of Animal Health and Production in Africa
Guide for Preparation of Papers
Notes to Authors

The Editor in Chief
March 2011

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The Bulletin of Animal Health and Production in Africa (BAHPA) of the African Union Interafrican Bureau for Animal Resources (AU-IBAR) is a scientific journal which publishes articles on research relevant to animal health and production including wildlife and fisheries contributing to the human wellbeing, food security, poverty alleviation and sustainable development in Africa. The bulletin disseminates technical recommendations on animal health and production to stakeholders, including policy makers, researchers and scientists in member states.

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