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BULLETIN OF ANIMAL HEALTH AND PRODUCTION IN AFRICA
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# BULLETIN OF ANIMAL HEALTH AND PRODUCTION IN AFRICA

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PRELIMINARY STUDY ON THE MAJOR BOVINE TREMATODE INFECTIONS AROUND KEMISSIE, NORTHEASTERN ETHIOPIA AND TREATMENT TRIAL WITH PRAZIQUANTEL

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ÉTUDE PRELIMINAIRE SUR LES PRINCIPALES INFECTIONS PAR LES TREMATODES BOVINS DANS LES ENVIRONS DE KEMISSIE AU NORD-EST DE L'ETHIOPIE ET ESSAI DE TRAITEMENT AU PRAZIQUANTEL

Résumé

Une enquête transversale a été menée dans les environs de Kemissie au nord-est de l'Éthiopie, afin de déterminer la prévalence des infections par les trématodes bovins (la distomiasie, la paramphistomiase et la schistosomiase), l'apparition des hôtes intermédiaires (les escargots) et pour évaluer l'efficacité du traitement au praziquantel. Les échantillons fécaux étaient recueillis du rectum de 429 zébus puis examinés. Une enquête malacologique parallèle a été réalisée dans les aires de pâturage et aux points d'abreuvement. La prévalence de la distomiasie, de la paramphistomiase et de la schistosomiase bovines était respectivement de 47%, 75% et 28%. Les conclusions de l'enquête malacologique ont révélé la présence de Lymnaea natalensis, Lymnaea truncatula, Biomphalaria pfeifferi et de l'espèce Bulinus sur le site d'étude. L'efficacité du traitement au praziquantel était statistiquement significative pour toutes les trois infections par les trématodes (la distomiasie : X² = 12.5; P < 0.01; la paramphistomiase : X² = 16.67; P < 0.01; la schistosomiase : X² = 16.07; P < 0.01). Les résultats de cette enquête préliminaire ont montré l'endémicité des infections par les trématodes bovins et l'apparition de leurs hôtes intermédiaires (les escargots) dans les environs de Kemissie. Les résultats ont, par ailleurs, indiqué que l'on devrait utiliser le praziquantel pour le traitement des infestations par les trématodes, en particulier dans les zones où sévissent les infections mixtes. L'utilisation éventuelle de Phytolacca dodecandra (une plante mollusccicide) contre les escargots (hôtes intermédiaires), qui revêt une importance vétérinaire, est discutée.

Mots-clés : bovin, prévalence, praziquantel, escargot, trématode, Kemissie

Summary

A cross-sectional survey was conducted around Kemissie, Northeastern Ethiopia, to determine the prevalence of bovine trematode infections (fascioliasis, paramphistomiasis and schistosomiasis), the occurrence of their intermediate snail hosts and to evaluate the efficacy of treatment with praziquantel. Faecal samples were collected from the rectum of 429 zebu cattle and examined qualitatively. A parallel malacological survey was made in grazing and watering sites. The prevalence of bovine fascioliasis, paramphistomiasis and schistosomiasis was found to be 47%, 75% and 28%, respectively. The results of the malacological survey demonstrated the existence of Lymnaea natalensis, Lymnaea truncatula, Biomphalaria pfeifferi and Bulinus species in the study site. The efficacy of treatment with praziquantel was statistically significant for all the three trematode infections (fascioliasis: X² = 12.5, p<0.01; paramphistomiasis: X² = 16.67, p<0.01; schistosomiasis: X² = 16.07, p<0.01). The results of this preliminary survey showed the endemcity of bovine trematode infections and the occurrence of their intermediate snail hosts around Kemissie. The results further indicated that praziquantel would be used for the treatment of these trematodiases especially in the areas with mixed infections. The possible use of Phytolacca dodecandra (a mollusccicide plant) against snail intermediate hosts of veterinary importance is discussed.

Key words: bovine, prevalence, praziquantel, snail, trematode, Kemissie

Introduction

Bovine trematode infections are economically important diseases of cattle transmitted by snail intermediate hosts. Fasciola infection occurs commonly as a chronic disease in cattle and its severity depends on the nutritional status of the host1. It is a great drawback to ruminant production in Ethiopia2,3. Numerous coprological and slaughter-house studies showed a high occurrence and widespread distribution of fascioliasis in ruminants in Ethiopia4,5,6. Even though fascioliasis is

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wide spread in the country, published materials are scarce on the disease. Bovine schistosomiasis, mainly caused by *Schistosoma bovis* is widely distributed in the Northeastern and Central Africa. In the Sudan the prevalence rate ranges between 37.2% and 90.8% Dinnik and Dinnik® in the abattoir survey reported 49% infection rate in cattle in Uganda, 52% in Northern Tanzania and up to 100% in Egypt. In Ethiopia, Lo and Lemma and Solomon reported the occurrence of bovine schistosomiasis. Solomon recorded a prevalence rate of 33.8% in Bahir Dar, Northwestern Ethiopia. There has been no work done so far since then. Additionally, except for the report of Graber and Mukasa-Mugerwa et al, there is no information on the occurrence and distribution of paramphistomiasis in Ethiopia.

Praziquantel is a heterocyclic pyrazine-isoquinoline which structurally unrelated to other anthelmintics and is highly active against a wide range of trematodes. The efficacy of this drug on nematodes of veterinary importance has not been established so far. This study was undertaken to generate baseline information on bovine trematode infections around Kemissie, Northeastern Ethiopia, and to evaluate the efficacy of praziquantel for the treatment of these infections.

**Materials and Methods**

**Study area**

The study was conducted at the villages surrounding Kemissie, a town of the Oromia Zone of Amahara Region, located at 325km. Northeastern of Addis Ababa in the southern Wello. Three villages namely, Gebri, Cherety and Weledi situated around Kemissie within a radius of 20km. were the study sites. The study area has the largest cattle population in the region and it is estimated that the ratio of livestock numbers to family members is 5:1 (personnal comm.). The area is plain and swampy. The altitude of the area ranges from 1000-2000m. Average annual rainfall and mean annual temperature are 1600mm and 30°C, respectively.

**Study animals and sampling**

Multi-stage sampling involving three stages was employed to select the study animals. In this method, geographic areas (villages) around Kemissie (Gerbi, Cherety and Weledi) were selected systematically out of six villages and were considred as the primary units. Within these areas herds were considred to be secondary units while animals in each herd were classified as tertiary units. The sample size was calculated by estimating the prevalence bovine schistosomiasis and fascioliasis to be 30% and 50% respectively in the study area, assuming the minimum detectable difference between the estimated and actual prevalence for each disease to be about 5% with 95% confidence level. On the basis of this calculation, 336 or more animals were required for schistosomiasis and fascioliasis investigations respectively. Hence, the sum of 429 zebu from the three villages was used. From these three villages 30 herds (10 herds from each village) owned by farmers were randomly selected. Similarly, within a herd on average, 14 animals were selected randomly for the collection of faecal samples.

**Faecal Examination**

Faecal samples were collected from the rectum of each study animal, placed in plastic vials and fixed with 3% formalin. A sedimentation technique as described by Hansen and Perry was used to detect the presence of trematode eggs. Smears were stained with methylene blue for the differentiation of eggs of *Fasciola* and *Paramphistomum*.
**Malacology**

Snails were collected from grazing and watering sites three times during the short rainy season (March, April and May) by hand picking and scooping methods. Identification of snails was made on the basis of shell morphology at the field and/or in the malacology laboratory of the Institute of Pathobiology using a field guide to African freshwater snails.

**De-worming**

After collection of faecal samples on average 42 cattle per village and a total of 126 were selected on the basis of convenience for follow up and ear-tagged. They were administered with praziquantel orally at a dose rate of 30 mg/kg. Ten days later faecal samples were collected from the rectum of these animals and examined for eggs of *Fasciola, Paramphistomum* and *Schistosoma*.

**Data analysis**

The magnitude of infection with the three parasite genera and the proportion of the species of snails collected were expressed in percentages. The efficacy of praziquantel for the treatment of the three parasitic diseases was assessed using chi-square.

**Results**

The average prevalence of bovine fascioliasis, paramphistomiasis and schistosomiasis recorded were 47%, 75% and 28% respectively. 13% of the study animals had triple infections and 33% of them had double infections. Figure 1 shows the prevalence of the three parasitic infections in the three villages around Kemissie. The prevalence of paramphistomiasis was the highest at all the three villages, particularly at Gerbi and Weledi.

The difference in prevalence of paramphistomiasis between Gerbi and Cherety was statistically significant ($X^2 = 26.89, p<0.01$). The prevalence of schistosomiasis was the lowest at the three villages relative to the other two trematode infections. There was a statistically significant ($X^2 = 18.43, p<0.01$) difference in prevalence of schistosomiasis at Gerbi and Weledi. On the other hand, the difference in prevalence of fascioliasis at the three villages was not significant.

Malacological survey at the study area indicated the existence of *Lymnaea natalensis*, *Lymnae truncatula*, *Biomphalaria pfeifferi* and species in the watering and grazing sites. Figure 2 shows the average proportion of snail species collected three times during the short rainy season. *B. pfeifferi* was the most abundantly found species of snail followed by *L. natalensis*. Similarly, *Bulinus* species and *L. truncatula* were found to occur in good proportions.

The efficacy of treatment with praziquantel at a dose rate of 30 mg/kg body weight was statistically significant against all the three trematode infections (fascioliasis: $X^2 = 12.5$, $p<0.01$; paramphistomiasis: $X^2 = 16.67$, $p<0.01$; schistosomiasis: $X^2 = 16.07$, $p<0.01$).

**Discussion**

The current survey has shown that all the three trematode infections are widespread around Kemissie. This is the first report as there has not been such a study in the area so far. Paramphistomiasis was the most prevalent followed by fascioliasis and schistosomiasis. The prevalence of fascioliasis at the three villages was similar but those of schistosomiasis and paramphistomiasis were lower at Weledi and Cherety, respectively. These variations in the prevalence of trematode infections are attributed to the difference in the occurrence and distribution of the intermediate snail hosts, which in turn is
Figure 1. Prevalences of bovine trematode infections in three villages around Kermisse.

Figure 2. Percentage of species of snail collected from the study area.
due to variation in the environmental conditions. Paramphistomum is found in the rumen in large numbers and little is known about its pathological significance. As this parasite is histophagous and possibly haematophagous it may cause severe economic losses especially in young animals. The average prevalence of schistosomiasis recorded by present study (28%) is lower than that reported (33.8%) by Solomon around Lake Tana, Northwestern Ethiopia. Although both paramphistomiasis and schistosomiasis have economic significance, they have been given little attention and their magnitudes may be masked by fascioliasis. Prevalence values closer to that of the present study have been recorded for fascioliasis previously by other workers in different parts of the country. In Ethiopia, F. hepatica is widely distributed in areas with altitude above 1800m while F. gigantica appears to be the most common species in places with altitude below 1200m. Mixed infections occur where the altitude ranges between 1200m and 1800m, such as of Kemissie and its surrounding.

One of the most important factors for the occurrences of these trematode infections is the presence of snail intermediate hosts and the favorable environmental conditions for their breeding. B. pfeifferi and L. natalensis were the predominant snails species collected from the study sites. Bulinus species and L. truncatula were also not uncommon. The economic loss caused by these trematode infections is straightforward in such locally conducive environmental conditions as animals are exposed to large doses of infection. Preliminary evaluation test on the basis of qualitative faecal analysis done in the present study indicated that praziquantel is effective against all the three parasites. It is of particular value in animals with mixed infection and to two countries like Ethiopia regarding the cost and availability of praziquantel. On the other hand, it is more advantageous to target the intermediate snail hosts. In Ethiopia, control of human schistosomiasis is underway by applying Phytolacca dodecandra, a molluscicidal plant in streams and swampy areas favorable for the breeding of snails. Similar application should be tried on snails of veterinary importance and its effect should be evaluated.

Acknowledgements

The authors acknowledge the Medical Parasitology of the Institute of Pathobiology for the supply of the drug and financial support.

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SEASONAL AVAILABILITY OF INFECTIVE STRONGYLATE NEMATODE LARVAE ON PASTURE IN THE FOREST ZONE OF GHANA

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PRESENCE SAISONNIÈRE DES LARVES INFECTANTES DE STRONGYLE SUR LES PÂTRURAGES DANS LA ZONE FORESTIERE DU GHANA

Résumé

La présence des larves infectantes de strongyle sur les pâturages dans la zone forestière du Ghana a été surveillée pendant plus d’un an et demi. Les larves infectantes de strongyle (L₃s) ont atteint un maximum de 3026 kg⁻¹ MS en juin, qui est la saison des fortes pluies. Il y avait des larves infectantes de strongyle sur les pâturages pendant toute l’année. Toutefois, le nombre variait d’un mois à l’autre, avec le mois de décembre ayant un niveau plus élevé de L₃s que la même période de l’année précédente. Il est possible que le feuillage touffu des arbres dans les régions forestières, qui favorise la formation de rosée, n’ait pas permis à l’humidité d’être un facteur restrictif ; il a, par ailleurs, intensifié la présence des larves infectantes pendant la période sèche entre novembre et février.

Summary

The availability of infective strongylate nematode larvae on pasture in the Forest zone of Ghana was monitored for over one and a half years. Infective strongylate nematode larvae (L₃s) peaked at 3026 Kg⁻¹ DM in June which is the peak of the rainfall season. There were infective strongylate nematode larvae on pasture throughout the year, however, the number varied month by month with December 1995 showing a higher level of L₃s than the same period in the previous year. It is likely, the closed tree canopy in the forest regions which supports and sustains dew formation, did not allow moisture to be a limiting factor and promoted the availability of infective larvae during the dry period between November and February.

Introduction

The rate of development of infective larvae and their survival on pasture are influenced by climatic factors including moisture, temperature and humidity which vary between the different geo-ecological zones¹²³. Michel⁴ indicated that climatic factors were more important in the determination of the availability of L₃s on pasture than vegetation profile. Agyei⁵ showed that in the Coastal Savanna regions rainfall was the most important factor in view of the equable temperatures and relative humidity and rainfall⁶ and the dense tree canopy further creates a prolonged early morning dew⁷ providing moisture which is important to the movement of L₃s⁸ and availability of L₃s on pasture. The distribution of infective larvae on pasture affects the worm burden of the host and the seasonal availability is the key factor in the recurrence and severity of worm infections.

The Forest Zone has begun to assume importance in livestock production and this is being driven by the year round availability of grazing material. The prolonged early morning dew may probably produce availability of grazing material. The prolonged early morning dew may probably produce a favourable microclimate for the development and survival of L₃s during the drier months of the year when the Coastal Savanna regions are considered sterile²⁵.

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This would influence the year round availability of L₃'s on pasture and this paper reports on the seasonal distribution of L₃'s on pasture in a Forest Zone of Ghana.

Materials and Methods

The study was carried out at the Agricultural Research Station (ARS), University of Ghana, Kade, which lies on longitude 0°49' W and latitude 6°06'N. The site has adequately been described by Nuvor et al and the vegetation is semi-deciduous. The tree crops consisted of oil palm, kola, rubber, citrus, and cocoa among others and sheep graze under the plantations. The climatic conditions were recorded for the farm by the Meteorological Services, Kade.

Two 0.40 ha plots at ARS, Kade, were demarcated within the grazing fields of the plantation and used; 500 sheep of different ages and sexes were allowed to graze daily the area including the plots, each of which had a drinking water trough. Sampling of pasture for herb age infective larvae was carried out fortnightly as described in MAFF\textsuperscript{10} from December 1994 to June 1996. For the recovery of herb age L₃'s, samples were processed using standard procedures as described by Lancaster\textsuperscript{11}.

Correlation analysis was used to assess the relationship between the amount of rainfall and the number of raindays with the number of L₃'s on pasture during the period.

Results

The amount of rainfall declined from November until December 1994 when there was no rain. There was some rainfall in January 1995 and very little in February but peaked in April (Fig. 1). It peaked again in August but declined until January 1996. It rose the following February only to peak in March but fell again until the end of the observations. The number of rain days (Fig. 1) in most cases was related to the amount of rainfall. The number of raindays in April 1996 was 12 with the amount of rainfall being 149 mm compared to April 1995 when the number was 12 with the amount of rainfall being 200 mm. In May 1995 the number of rainy days was 10 and the amount was 200 mm but in May 1996 though the number of rainy days was the same the amount of rainfall was 145 mm. The number of rainy days was 12 in June 1995 the amount of rainfall was 210 mm whilst the same number of raindays in June 1996 yielded 98 mm of rainfall (Fig. 1).
Figs 2 (a). Mean total number and (b) Types of $L_3$ s recovered from pasture at Kade
Figures 2a and b show the mean total number and the generic composition of \( L_3 \)s on pasture from December 1994 to June 1996. The order of prevalence of \( L_3 \)s was *Haemonchus* spp, *Oesophagostomum* sp, *Trichostrongylus* spp, *Coopera* spp, *Ostertagia*-like, and *Bunostomum trigonoscephalum*. There were \( L_3 \)s on pasture throughout the sampling period even in December 1994 when there was rainfall. The level of \( L_3 \)s started to pick up in April and was high in June, but declined in July until November. It rose again in December 1995 only to fall in January 1996. It fluctuated between February and April and peaked in May but declined in June 1996.

The relationship between the number of \( L_3 \)s on pasture and the amount of rainfall showed coefficient of 0.68 but was significant (\( P<0.05 \)).

**Discussion**

The results of this study showed that there were infective strongylate nematode larvae on pasture throughout the whole year. The presence of higher level of \( L_3 \)s on pasture in December, a normally dry month contrasting the report from Coastal Savanna regions\(^5\) may suggest that the amount of moisture from the early morning dew and the closed tree canopy was enough to sustain the \( L_3 \)s on pasture. It could possibly also result from the distribution of rainfall\(^5\) for it was observed that though December 1995 may have had a smaller amount of rainfall, there were more raindays indicating a better distribution and possibly a higher availability of \( L_3 \)s on herbage than December the previous year. The precence of \( L_3 \)s on pasture the previous December which was without rainfall could suggest that moisture was not a limiting factor as observed during certain times in the Coastal Savanna areas. However, the high number of \( L_3 \)s seen on pasture in December 1995 was probably augmented by the release of high number of worm eggs due to the periparturient rise in worm egg counts\(^12\) in the ewes due to the lambing which occurred on the farm in November prior to that December. The release of a large number of susceptible lambs onto the pasture with subsequent in creased output of worm from the lambs and the rainfall that month, were all factors that could also contribute to the increase in the level of \( L_3 \)s on pasture during December considered a dry and sterile month\(^2\). The higher contribution of *Haemonchus conortus* \( L_3 \)s to the total number of \( L_3 \)s on pasture conffirms previous findings\(^5\). Njanja\(^13\) has observed that infection with *Haemonchus conortus* alone in the humid ecozones may cause up to 44% mortalities in sheep.

It observed that the amount of rainfall did not always correspond to the number of raindays and also varied between the same months in the different years. However, the existence of positive relationship between the number of infective larvae on pasture and the amount of rainfall support the view that rainfall could be used to predict the level of \( L_3 \)s on pasture\(^5\).

It could be concluded that, the favorable microclimate existing as a result of the closed tree canopy in the Forest Zone, which supports and sustains dew formation, did not allow either the lack of or insufficient moisture during the drier months to influence significantly availability of \( L_3 \)s on herbage. This is so because moisture was not limiting factor as it occurs during the dry season in the Coastal Savanna areas. This situation would influence the pattern of worm infection and therefore should be borne in mind in the development of strategic intervention for control of nematodes in lambs in the forest regions.

**Acknowledgement**

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sitology Laboratory, Achimota for their patience, support and interest and to Prof. E.O. Otchere, Director, Animal Research Institute, Achimota, for encouragement. ADA acknowledges the support of IFS to the Project.

References


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The relationship between the number of days in each month from 1913 to 1938 was determined using a regression analysis. The equation for the regression line was found to be:

\[ y = 30.47 + 0.13x \]

where \( y \) is the number of days in a month and \( x \) is the month number (1 for January, 2 for February, etc.).

The correlation coefficient of 0.9948 indicates a strong positive correlation between the number of days in each month and the month number.

The results of the analysis were used to develop a model for predicting the number of days in each month for future years. This model can be used for various purposes, such as agricultural planning and weather forecasting.

Acknowledgements

We are most grateful to the staff of the Smith, Brown, and Associates, Inc., for their cooperation in providing the necessary data for this study.
COMPARATIVE STUDIES ON THE INFLUENCE OF SUPPLEMENTATION WITH TWO LEGUMES (ARACHIS GLABRATA BENTH AND DESMODIUM INTORTUM) ON THE REPRODUCTIVE AND GROWTH PERFORMANCE OF GUINEA PIGS (CAVIA PORCELLUS L.)

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ETUDES COMPARATIVES SUR L'EFFET DE LA SUPPLEMENTATION AVEC DEUX LEGUMINEUSES (ARACHIS GLABRATA ET DESMODIUM INTORTUM) SUR LA PERFORMANCE DE REPRODUCTION ET DE CROISSANCE DES COBAYES (CAVIA PORCELLUS L.)

Résumé

Quarante-huit cobayes adultes (Cavia porcellus) composés de 45 femelles et de 3 mâles ont été utilisés dans une étude qui a duré quatre mois, afin de comparer l'effet de la supplémentation, avec Arachis glabrata ou Desmodium intortum, d'un aliment de base contenant Trypsacum laxum et de nourriture pour lapin, sur leur performance de reproduction et de croissance. Les animaux étaient répartis en trois groupes égaux (1 mâle et 15 femelles chacun), qui correspondaient aux aliments d'expérience suivants : le groupe "aliment de base" (GAB), le groupe supplémenté avec Arachis (GSA) et le groupe supplémenté avec Desmodium (GSD). Les résultats ont montré que le taux de fertilité était bien plus élevé (P < 0,1) pour GSA (93,3%) et GSD (73,3%) par rapport à GAB (40%). Les poids à la naissance et la viabilité au sevrage qui étaient respectivement de 100,1 g ; 98,9 g et 96,9 g, et 100% ; 84,7% et 50% ont suivi la même tendance. Aucune différence significative n'a été constatée pour les poids à la naissance. En revanche, la viabilité à la naissance a révélé une variation importante (P < 0,1) entre GSA et les deux autres groupes. Les valeurs moyennes pour le gain pondéral quotidien étaient plus élevées chez GSD (4,5 ± 1,6 g) comparé à GSA (3,5 ± 1 g) et GAB (1,5 ± 1,2 g). Les valeurs pour ce paramètre étaient beaucoup plus élevées chez GSA et GSD que chez GAB. Les poids moyens au sevrage pour GSA, GSD et GAB étaient respectivement de 173,6 ± 4,9 g ; 194 ± 7,1 g et 161,4 ± 4,9 g. Aucune différence significative (P > 0,05) n'a été notée pour les poids au sevrage. Les résultats ont révélé que l'alimentation des cobayes avec un supplément de légumineuse a amélioré la performance de reproduction et de croissance.

Summary

Forty eight adult guinea pigs (Cavia porcellus) comprising of 45 females and 3 males were used in a four-month study to compare the effect of supplementation with Arachis glabrata or Desmodium intortum of a basal diet containing Trypsacum laxum and rabbit feed on their reproductive and growth performance. Animals were divided into three equal groups (1 male and 15 females each) corresponding to the experimental diets namely the basal diet group (BDG), the Arachis supplemented group (ASG) and the Desmodium supplemented group (DSG). The results showed that the fertility rate was significantly higher (P<0.1) for ASG (93.3%) and DSG (73.3%) than the BDG (40.0%). Birth weights and viability at weaning which were respectively 100.1 g, 98.9 g and 96.9 g and 100.0%, 84.7% and 50.0% followed the same trend. No significant difference was observed for the birth weights. Contrarily, viability at birth showed a significant variation (P<0.1) between ASG and the other two groups. Mean values for the daily weight gain were higher in DSG (4.5±1.6) than ASG (3.5±1) and BDG (1.5±1.2). Values for this parameter were significantly higher in ASG and DSG than in BDG. The mean weaning weights for ASG, DSG and BDG were 173.6±4.9, 194±7.1 and 161.4±4.9 respectively. No significant differences (P>0.05) were observed for the weaning weights. The results revealed that feeding of guinea pigs with additional vegetable improved reproductive and growth performances.

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Introduction

In many countries, the world over, there is a disequilibrium between the demand for food and quantity of food available especially animal proteins. According to Deschuyteneer\(^1\), consumption of meat in many African countries does not exceed 10kg per caput per annum. The lack of adequate space and financial means for conventional livestock production is expected to aggravate this dearth of animal protein intake. This has rekindled interest in recent years to the production of non-conventional animal species notably microlivestock such as guinea pigs and quails.

Guinea pigs are promising microlivestock due to the fact that they require little capital or labour, provide an inexpensive readily available, palatable meat, have no odour and are suitable for keeping indoors\(^2\). Their low cost and size makes them accessible to many landless peasants and can serve as excellent sources of supplementary income for these farmers. The guinea pig is widely distributed throughout Latin America where their production has been improved with modern production practices. They are also raised as a food resource in parts of Africa especially West and Central Africa\(^3\).

In Cameroon production of guinea pigs is mainly by the traditional system which is characterised by poor nutrition (especially with protein nutrition) obtained mainly by feeding kitchen wastes and farm residues.

Forage legumes as supplements can considerably improve the productivity of these animals. Not only are these legumes cheaper than most agro-industrial by-products (cottonseed cake, soybean meal, groundnut cake, etc) used as protein supplements, they are also available on a year-round basis and can be grown (without the need for extra cost on fertilisers) by the farmers themselves. \textit{Arachis glabrata} which was introduced to Dschang University in 1985 from the University of Florida\(^4\) is well adapted to the climate and is resistant to drought, disease and insect pests\(^4\).

\textit{Desmodium intortum} on the other hand is locally available in the wild and is widely distributed in this region and also thrives well during the dry season. The objective of this work is to investigate the influence of feeding these two legumes as protein supplements on the reproductive and growth performance of local guinea pigs.

Material and Methods

Forty-eight adult guinea pigs made up of 45 females and 3 males were used. Average initial weight of the animals was 450g. After a week of stabilisation, these animals were divided into three equal groups according their sex and weights. These groups were raised in a brooding house with identical spaces of 2.88m sq. provided and separated by aluminium sheets. Litter material was used in the pens and replaced to avoid accumulation of urine and faeces. A 100 watt bulb was provided for each pen for a period of one month.

Feeding management

The quantity of feed given was adjusted as the number of animals in each treatment increased. The three diets used in the study were randomly allotted to the groups of animals. These diets were denoted as follows: ASG constituted of Rabbit feed, \textit{Tryptacum laxum} and \textit{Arachis glabrata}; DSG constituted of Rabbit feed, \textit{Tryptacum laxum} and, \textit{Desmodium intortum} and BDG constituted of Rabbit feed and \textit{Tryptacum laxum}. \textit{Tryptacum laxum} was given free choice while 400g of rabbit feed and 2kg of each legume was
given daily to the respective treatment groups. The percentage composition of the rabbit feed is shown in Table 1.

**Trial management**

The experiment which lasted for 4 months (mid-July to mid-November 1999) consisted of a basal daily diet of *Trypsacum laxum* and 400g of rabbit feed for all the three treatment groups. Treatments ASG and DSG received an additional daily provision of 2kg fresh *Arachis glabrata* and *Desmodium intortum* respectively while the control group received only the basal diet (BDG).

**Data collection and analysis**

Data on fertility, type of birth, litter size were recorded for the reproductive performance while birth weight, weaning weights (21 days of age) and daily weight gains were recorded for the growth performances. The fertility, viability at birth and weaning and the type of birth being binomial traits were analysed alternately using the students’ t-test at 10% probability level while the other parameters were analysed using the analysis of variance at the 5% level of significance.

**Results**

**Diets**

The proximate composition (on dry matter basis) of the various diets used in the feeding trial are shown in Table 2.

**Reproductive performance**

Results of the effect of protein source on the reproductive performance are shown in Table 3. Results show a higher fertility rate for animals supplemented with *Arachis* (ASG) followed by the Desmodium supplemented group (DSG). There was no significant difference (P>0.1) in fertility between these two groups. However the fertility rate of the control group was significantly (P<0.01) lower than either of the two groups. Multiple births were observed in all the treatment groups. Paradoxically multiple births were higher for the basal diet (BDG) than for ASG and DSG. However, the highest litter sizes were obtained from ASG and DSG. Statistical analysis showed that BDG and ASG are comparable for these two parameters and are significantly higher (P<0.1) than DSG. The viability at birth was higher for ASG and DSG than BDG. There was no significant difference (P>0.1) between the groups. Animals in ASG showed significantly higher (P<0.1) viabilities than those for DSG and BDG which were statistically at par. The viability at weaning for twin birth was also highest for ASG followed by DSG and BDG. For triple births ASG and DSG recorded higher viabilities than BDG. These differences were however not statistically significant (P>0.1).

**Growth performance**

Results of the influence of protein source on growth performance are shown in Tables 4, 5 and 6. Table 4 summarises the effect of the protein source on birth weight. Independent of type of birth and sex, the mean values for the birth weight were higher for ASG followed by DSG and BDG. There were however no significant differences (P>0.05) between these three groups for this parameter. If consideration is given to the sex, the birth weight of the males in BDG were higher than those for DSG while females of ASG were heavier than those for DSG. There were also no significant (P>0.05) differences between treatments for the sexes. The twin births also had a similar trend. For triple births however the mean birth weight was higher for ASG followed by BDG. There were no significant (P>0.05) differences between the treatments for this parameter irrespective of the type of birth.

Table 5 shows the comparative analy
sis of the growth to weaning (daily weight gains) for the different treatments. Independent of the type of birth and sex the daily weight gains were higher in DSG followed by ASG. These two groups had significantly higher (P<0.05) daily weight gains than BDG. If sexes are considered males of ASG had higher weight gains than those of DSG and BDG respectively. No significant differences were observed between the males for the different treatments. Contrarily females of DSG recorded higher (P<0.05) weight gains than those for ASG. There was no significant difference in daily weight gain between ASG and BDG. Taking into consideration the type of birth there was no significant (P>0.05) difference in daily weight gain of twin birth for all the three treatments. For the triple birth, animals of ASG had significantly higher (P<0.05) daily weight gains than those of DSG which were also significantly higher than BDG.

Weaning Weight

Table 6 shows the comparative analysis of the influence of protein source on weaning weight. Independent of the type of birth and sex, the weaning weight was highest for ASG followed by DSG and BDG. There were however no significant (P>0.05) differences between the treatments groups for the weaning weight. Considering the sexes males of ASG recorded

<table>
<thead>
<tr>
<th>Table 1 : Percentage composition of the rabbit feed.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingredients</td>
</tr>
<tr>
<td>Maize</td>
</tr>
<tr>
<td>Wheat offal</td>
</tr>
<tr>
<td>Rice bran</td>
</tr>
<tr>
<td>Palm kernel cake</td>
</tr>
<tr>
<td>Cottonseed cake</td>
</tr>
<tr>
<td>Soyabean</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2: Proximate Composition of the protein sources used (on dry matter basis).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein source</td>
</tr>
<tr>
<td>Dry matter</td>
</tr>
<tr>
<td>Crude protein</td>
</tr>
<tr>
<td>Ether extract</td>
</tr>
<tr>
<td>Crude fibre</td>
</tr>
<tr>
<td>Ash</td>
</tr>
</tbody>
</table>

Source: * Momento de l'agronome  
** Laboratory analysis  
*** Calculated analysis following nutrient levels obtained from Momento de l'agromie and laboratory analysis of wheat offal.
Table 3: Effect of protein source on the reproductive performance of guinea pigs.

<table>
<thead>
<tr>
<th>Reproductive parameter</th>
<th>ASG</th>
<th>DSG</th>
<th>BDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of females</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Fertility rate (%)</td>
<td>93.3a</td>
<td>73.3a</td>
<td>40.0b</td>
</tr>
<tr>
<td>Type of birth (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>33.3a</td>
<td>66.7b</td>
<td>16.4a</td>
</tr>
<tr>
<td>(5)</td>
<td></td>
<td>(8)</td>
<td>(1)</td>
</tr>
<tr>
<td>Multiple</td>
<td>66.7a</td>
<td>33.3b</td>
<td>83.6a</td>
</tr>
<tr>
<td>(10)</td>
<td></td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Litter size</td>
<td>1.7±0.7ab</td>
<td>1.4±0.8b</td>
<td>2.2±0.8a</td>
</tr>
<tr>
<td>(15)</td>
<td>(12)</td>
<td>(6)</td>
<td></td>
</tr>
<tr>
<td>Viability (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At birth</td>
<td>100.0a</td>
<td>100.0a</td>
<td>83.3a</td>
</tr>
<tr>
<td>(26)</td>
<td>(17)</td>
<td>(13)</td>
<td></td>
</tr>
<tr>
<td>At weaning</td>
<td>100.0a</td>
<td>87.5a</td>
<td></td>
</tr>
<tr>
<td>(5)</td>
<td>(8)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twin birth</td>
<td>100.0a</td>
<td>87.5a</td>
<td>66.7b</td>
</tr>
<tr>
<td>(18)</td>
<td>(5)</td>
<td>(6)</td>
<td></td>
</tr>
<tr>
<td>Triple birth</td>
<td>100.0a</td>
<td>100.0a</td>
<td>50.0b</td>
</tr>
<tr>
<td>Mean</td>
<td>100.0a</td>
<td>84.7b</td>
<td>58.3b</td>
</tr>
<tr>
<td>(3)</td>
<td>(3)</td>
<td>(6)</td>
<td></td>
</tr>
<tr>
<td>Mortality of females (%)</td>
<td>0</td>
<td>0</td>
<td>13.3</td>
</tr>
<tr>
<td>(15)</td>
<td>(19)</td>
<td>(15)</td>
<td></td>
</tr>
</tbody>
</table>

abc P<0.1

( ) The values in parenthesis represent the number of observations.

The highest weaning weights followed by BDG. There was however no significant difference between the three treatments. For females, significantly higher (P<0.05) weaning weights were observed for DSG than ASG which were also significantly higher than BDG. The weaning weights for single birth were higher for ASG than DSG although no significant differences were observed. Significantly higher weaning weights for twin births were observed for ASG and DSG than BDG. The wean
Table 4: Effect of source of protein on birth weight (grams).

<table>
<thead>
<tr>
<th>Treatment groups</th>
<th>ASG</th>
<th>DSG</th>
<th>BDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of birth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single birth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>106.0±4.2a</td>
<td>100.0±4.2a</td>
<td>-</td>
</tr>
<tr>
<td>(3)</td>
<td>(3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>115.0</td>
<td>105.0±3.2</td>
<td></td>
</tr>
<tr>
<td>(1)</td>
<td>(3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male/Female</td>
<td>107.0±3.0a</td>
<td>104.4±3.2a</td>
<td>100.0</td>
</tr>
<tr>
<td>(5)</td>
<td>(8)</td>
<td>(1)</td>
<td></td>
</tr>
<tr>
<td>Twin birth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>106.0±2.0a</td>
<td>110.7±5.0a</td>
<td>98.3±1.7a</td>
</tr>
<tr>
<td>(8)</td>
<td>(3)</td>
<td>(3)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>98.1±3.5a</td>
<td>145.0</td>
<td>90.0±3.6a</td>
</tr>
<tr>
<td>(8)</td>
<td>(1)</td>
<td>(3)</td>
<td></td>
</tr>
<tr>
<td>Male/Female</td>
<td>99.4±3.0a</td>
<td>93.4±5.7a</td>
<td>94.2±3.1</td>
</tr>
<tr>
<td>(18)</td>
<td>(6)</td>
<td>(6)</td>
<td></td>
</tr>
<tr>
<td>Triplet birth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>100.0</td>
<td>80.0</td>
<td>110.0</td>
</tr>
<tr>
<td>(3)</td>
<td>(3)</td>
<td>(6)</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>102.3±2.3a</td>
<td>105±4.5</td>
<td>112.0±4.5a</td>
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<tr>
<td>(11)</td>
<td>(6)</td>
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<tr>
<td>Female</td>
<td>100.0±3.3</td>
<td>97.9±4.9</td>
<td>95.6±2.8</td>
</tr>
<tr>
<td>(12)</td>
<td>(7)</td>
<td>(4)</td>
<td></td>
</tr>
<tr>
<td>Male/Female</td>
<td>100.1±2.9</td>
<td>98.9±5.0</td>
<td>96.9±4.6</td>
</tr>
<tr>
<td>(26)</td>
<td>(17)</td>
<td>(13)</td>
<td></td>
</tr>
</tbody>
</table>

a,b,c - P<0.05

( ) The values in parenthesis represent the number of observations.
### Table 5: Effect of source of protein on the daily weight gain (grams).

<table>
<thead>
<tr>
<th>Type of birth</th>
<th>Treatment groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ASG</td>
</tr>
<tr>
<td>Single birth</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>4.9±0.7&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(2)</td>
</tr>
<tr>
<td>Female</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>Male/Female</td>
<td>4.5±0.8&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(3)</td>
</tr>
<tr>
<td>Twin birth</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2.9±0.5&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(6)</td>
</tr>
<tr>
<td>Female</td>
<td>3.3±0.9&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(8)</td>
</tr>
<tr>
<td>Male/Female</td>
<td>3.1±1.0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(14)</td>
</tr>
<tr>
<td>Triple birth</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>4.2±0.7&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(3)</td>
</tr>
<tr>
<td>Male/Female</td>
<td>4.2±0.7&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(3)</td>
</tr>
<tr>
<td>Average</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>3.4±1.0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(8)</td>
</tr>
<tr>
<td>Female</td>
<td>3.5±1.1&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(12)</td>
</tr>
<tr>
<td>Male/Female</td>
<td>3.5±1.0&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(20)</td>
</tr>
</tbody>
</table>

<sup>a,b,c</sup> - P<0.05

( ) The values in parenthesis represent the number of observations.
### Table 6: Effect of source of protein on weight at weaning (grams).

<table>
<thead>
<tr>
<th>Type of birth</th>
<th>ASG</th>
<th>DSG</th>
<th>BDG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single birth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>211.0±2.4a</td>
<td>174.3±7.0a</td>
<td>-</td>
</tr>
<tr>
<td>(2)</td>
<td>(3)</td>
<td>(3)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>200.0</td>
<td>105.0±3.2</td>
<td>-</td>
</tr>
<tr>
<td>(1)</td>
<td>(3)</td>
<td>(3)</td>
<td></td>
</tr>
<tr>
<td>Male/Female</td>
<td>207.3±2.7a</td>
<td>195.5±6.7a</td>
<td>-</td>
</tr>
<tr>
<td>(3)</td>
<td>(6)</td>
<td>(6)</td>
<td></td>
</tr>
<tr>
<td>Twin birth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>161.4±3.9a</td>
<td>151.7±6.7a</td>
<td>150.0±0.0a</td>
</tr>
<tr>
<td>(6)</td>
<td>(3)</td>
<td>(2)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>164.4±4.9a</td>
<td>200.0</td>
<td>140.0±3.6a</td>
</tr>
<tr>
<td>(8)</td>
<td>(1)</td>
<td>(2)</td>
<td></td>
</tr>
<tr>
<td>Male/Female</td>
<td>163.2±4.4a</td>
<td>163.3±3.5a</td>
<td>1.9±1.0a</td>
</tr>
<tr>
<td>(14)</td>
<td>(4)</td>
<td>(4)</td>
<td></td>
</tr>
<tr>
<td>Triple birth</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>-</td>
<td>-</td>
<td>190.0±3.8</td>
</tr>
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<td>(2)</td>
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<tr>
<td>Female</td>
<td>188.3±3.2b</td>
<td>233.3±3.5b</td>
<td>165.6</td>
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<td>(3)</td>
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</tr>
<tr>
<td>Male/Female</td>
<td>188.3±3.2b</td>
<td>233.3±3.5b</td>
<td>181.7±4.2a</td>
</tr>
<tr>
<td>(3)</td>
<td>(3)</td>
<td>(3)</td>
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<tr>
<td>Average</td>
<td></td>
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<tr>
<td>Male</td>
<td>174.0±5.1a</td>
<td>163.0±6.6a</td>
<td>176.7±5.0a</td>
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<tr>
<td>(8)</td>
<td>(6)</td>
<td>(3)</td>
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<tr>
<td>Female</td>
<td>173.3±4.6b</td>
<td>222.4±6.5a</td>
<td>150.0±3.8c</td>
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<tr>
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<td>(7)</td>
<td>(3)</td>
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<tr>
<td>Male/Female</td>
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<td>194.5±7.1a</td>
<td>161.4±4.9a</td>
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<tr>
<td>(20)</td>
<td>(13)</td>
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*a,b,c* P<0.05

( ) The values in parenthesis represent the number of observations.
ing weights for single birth were higher for ASG than DSG although no significant differences were observed. Significantly higher weaning weights for twin birth were observed for ASG and DSG than BDG. For triple births DSG was significantly higher than ASG and BDG while ASG and BDG were statistically at par.

**Discussion**

The fertility rate of ASG agrees with the findings of Fotso et al.; who used the same supplement as protein source for guinea pigs. The differences in fertility rates between the groups could be attributed to the difference in the protein levels of their diets. The protein deficit of the basal diet (BDG) may not have permitted this group of animals to obtain their requirement for efficient reproduction. It is common knowledge that for mammals resumption of heat, ovulation and the development of the embryo are largely dependent on nutrition. Although multiple births were more frequent in BDG, the highest litter sizes were obtained from ASG and DSG. This could be so because the type of birth and litter size are known to be affected by the weight and age of the dam, the parity and the nutrition of the dam.

Values for the viability rate at birth for ASG and DSG were higher than those reported earlier using Arachis as supplement. The differences in the viability rates in this study between the treatments could have been attributed to the differences in the protein level of these treatments. This differences may be brought about by the linear difference in birth weight which is an important factor in suckling at birth, consequently increasing the viability of such animals at weaning. More so, higher birth weight has been reported to favour survival and rapid growth in goats. However, the protein level in the diets seem to influence the birth weight since there was a linear increase in birth weight with the level of protein in the diets.

The poor daily weight gains associated with the basal diet (BDG) could be attributed to the sub-optimal protein level of this diet as compared to the supplemental diets (ASG and DSG). The importance of proteins to the growth of animals especially young animals is widely recognised. Proteins are known to be precursors of numerous hormones and enzymes which make up 50% of dry matter of animal cells. Periquet and Derachet also observed that there was no growth for young rats fed protein deficient diets.

The results clearly highlights the importance of nutrition especially protein nutrition on the early growth performance of guinea pigs especially with regards to their weaning weights. Higher weaning weight at a given age reach puberty earlier than slower growing ones. This will enable successful early breeding and a reduction in generation interval also enabling faster improvement in flock productivity.

The results from this study suggest that supplementation with proteinous legume source improves the reproductive and growth performance of guinea pigs. From the legumes sources used, *Arachis glabrata* could be considered to give a better performance than *Desmodium intortum* although the later is a better supplement for pre-weaning weight gain than the former. However, the type of birth and litter size do not seem to be affected by legume protein supplementation. Further studies on the nutrient requirements of guinea pigs especially with regards to protein and energy requirements are recommended.

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EVALUATION OF ENZYME LINKED IMMUNOSORBENT ASSAY (ELISA) AND PATHOLOGICAL FINDINGS IN THE DIAGNOSIS OF TUBERCULOSIS IN CAMEL (CAMELUS DROMEDARIUS) IN EGYPT

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EVALUATION DU TITRAGE AVEC IMMUNOADSORBANT LIE A UNE ENZYME (TECHNIQUE ELISA) ET RESULTATS PATHOLOGIQUES DANS LE DIAGNOSTIC DE LA TUBERCULOSE CHEZ LES CHAMEAUX (CAMELUS DROMEDARIUS) EN EGYPTE

Résumé

Une technique ELISA modifiée pour l'évaluation sérologique d'une nouvelle clé-type d'interprétation au lieu de la clé actuelle du test unique intradermique à la tuberculine chez les chameaux a été appliquée sur des sérum prélevés à des animaux d'élevage et à des chameaux infectés expérimentalement avec Mycobacterium bovis avirulent.

Les résultats ont montré une forte spécificité de la nouvelle clé-type d'interprétation par rapport à la clé actuelle pour la détection des anticorps anti-tuberculeux dans le diagnostic sérologique de la tuberculose chez les chameaux. En outre, on a trouvé une bonne corrélation entre les résultats post-mortem, l'isolement bactériologique et les résultats de l'ELISA.

Du point de vue histopathologique, les lésions tuberculeuses chez les chameaux infectés expérimentalement étaient caractérisées par une réaction productive et prolifique du tissu conjonctif sans aucune réaction exsudative et par quelques cellules géantes typiques des lésions chroniques et ce, par contraste avec les lésions observées chez les ruminants domestiques. La principale caractéristique est une nécrose caséiforme avec une certaine calcification et quelques cellules géantes. On aperçoit rarement des bactéries acido-résistantes.

Summary

A modified ELISA for serological evaluation of new standard key instead of the present key interpretation of single intradermal tuberculin test in camels were conducted on sera taken from field animal and experimentally infected camels with avirulent Mycobacterium bovis.

The results showed a high specificity of newly standard key than the present key for the detection of anti-tuberculous antibodies in serodiagnosis of tuberculosis in camels. Moreover, a good correlation between post-mortem findings, bacteriological isolation and the ELISA test results was found.

Histopathologically, tuberculous lesions in experimentally infected camels were characterized by a productive and proliferative response of fibrous tissue with no exudative reaction and a few Langhà's giant cells. This is in contrast to lesions observed in domestic ruminants. The main feature of which is caseous necrosis with some calcification and few giant cells. Acid fast bacteria (AFB) are rarely evident.

Introduction

Unlike in other species of animals, serological diagnosis of tuberculosis among camels has received little attention. However, some authors1 reported a good correlation between a haemagglutination test and tuberculin tests, but concluded that the serological test needs more investigations to be used for diagnosis of tuberculosis in camels.

Enzyme Linked Immunosorbent Assay (ELISA) was recommended by many authors2,3,4 as a highly sensitive and specific serological test, as a complementary method to tuberculin test especially for anergic tuberculous cattle and for collective diagnosis to elucidate clinical suspicious of disease or in the first steps of control programs for identification of foci

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among cattle. In relation to camels, there is scanty information available in literature concerning the use of ELISA or pathological changes for the diagnosis of tuberculosis.

The purpose of this study was to use ELISA purified protein derivative (PPD) assay for serological evaluation of the newly standard interpretation key recommended in recent previous study for interpreting cervical skin intradermal tuberculosis test in camels which consider a positive reactor which gave more than 7 mm and 6.5 mm difference in skin fold thickness with human and bovine PPD tuberculin, respectively. Instead of the present key which consider the positive test gave more than 4 mm with both types of tuberculins. In addition, to determine the specific and characteristic gross and histopathological lesions of bovine tuberculosis in lymph node and other tissues or internal organs of slaughtered experimentally infected camels.

Material and Methods

Sera
A total of 111 serum samples were obtained from 107 camels in abattoirs and from 4 experimentally infected camels with M. bovis in the Faculty of Veterinary Medicine, Cairo University.

Antigen
Bovine supplied from the Veterinary Serum and Vaccine Research Institute (VSVRI), Cairo, Egypt was used for coating the ELISA plates in addition to human PPD tuberculin used with bovine PPD tuberculin for cervical intradermal tuberculin test in camels.

ELISA test procedure
ELISA was performed as described previously with some modification. Flat bottom microtitre plates (Dynatech) were coated with 50µl (10µg/ml) of bovine PPD antigen diluted mincarbonate buffer (pH 9.6) and incubated for 20 hours at 40°C in humidified atmosphere. After a single wash with PBS-Tween 20 (0.05% w/v) (PBST), wells were blocked with 200µl of dried milk diluted 1% w/v in PBST (PBSTM) and incubated for 1 hour at 37°C. The PBSTM was then tipped off and plates patted dry. Serum samples to be tested for antibody content were diluted 1:50 and added to 100µl/well and incubated at 37°C for 60 minutes. After 3 washings with phosphate buffered saline (PBS) (pH 7.4) containing 0.01% tween 20, 150µl of protein “A” horseradish peroxidase conjugate (1:1000) (PA-HRPO) was added to each well and plates were then incubated at 37°C for 60 minutes. The plates were then washed again three times followed by the incubation of substrate at 37°C for 15 minutes. A working solution of substrate was prepared using H2O2 and 2-2 azino-di (3 ethyl benthiosaline-6-sulphonate, ABTS) in citric acid. It was prepared by dissolving ABTS-5 mg in 10 ml citric acid buffer and 3ul 30% H2O2. The reaction was monitored by the optical density recorded at 405 nm in a Dynatech micro-ELISA autoreader. AN ELISA reading that is equal to or higher than double fold of the ELISA reading of the negative control is considered as positive.

Sensitivity and specificity of the present and new recommended standard keys for interpretation of skin reactions in camels in comparison to that of ELISA were calculated according to the recommended equations.

Histopathological investigation of experimentally infected camels
These were prepared from four experimentally infected camels with M. bovis which were slaughtered after 18 months post infection. Tissues specimens were collected from lymph nodes and internal or-
gans showing tuberculous lesion and fixed in 10% buffered formalin and processed for H & E staining.  

Post-mortem examination and bacteriological examination

All animals were examined carefully to detect any post-mortem changes including serial incision of all lymph nodes of animals. Direct smears were made from lesions for staining with Ziehl-Neelsen stain and samples were obtained for cultivations and performed by the standard procedures. Smears of all cultures were then stained with Ziehl-Neelsen and Gram stain.

Results

The results of ELISA test from the 107 camels by bovine PPD type of tuberculin are summarized in Table 1. Nine camels were reported as ELISA positive. Gross lesions (tuberculous-like lesion in necropsied animal) were detected in 12 camels only. By bacteriological examination, 2 M. bovis, 1 M. africanum, 5 isolates of Corynebacterium pseudotuberculosis, one of typical mycobacteria mixed with C. pseudotuberculosis, one typical Mycobacteria could be isolated and no isolates could be revealed from the last two camels. At the same time, no bacteria could be isolated from the rest of tuberculin positive camels.

Comparison of the present and new recommended standard keys for assaying tuberculin tests in camels is shown in Table 2 using the presently used standard key to evaluate skin reactions. Thirty one animals could be considered as positive skin reactors with PPD while with the bovine PPD tuberculin only 18 animals out of the 107 animals tested reacted positively. When skin reactions were evaluated using the new recommended standard, only 8 animals out of 107 camels considered positive with human tuberculin while with bovine PPD tuberculin 4 animals reacted positively.

The sensitivity and specificity of ELISA in the present and new recommended standard keys in Table 3 was based on data shown in Table 1. The sensitivity of mammalian and bovine PPD either interpreted by two types of interpretation was 100%, but specificity of skin reactions with mammalian PPD interpreted with the present and new standard key was 73.1 and 95.2%, respectively, while with bovine PPD was 85.6% and 99%, respectively. In ELISA, specificity was 94.2%.

Grossly, numerous tuberculous nodules of varying sizes and types were most commonly affecting the lungs, pleura, pericardium bronchial and mediastinal lymph nodes in addition to liver, kidneys and spleen. The lungs showed numerous miliary tubercles of varying size and age widely scattered on the surface and deep in the lung parenchyma. In addition, larger nodules up to 5 cm diameter and even large areas of the lung tissue appeared solid and caseated (Fig. IA). The pleura showed numerous raised plaques and masses of grape-like nodules attached to the diaphragmatic pleura and that of the chest wall. Discrete dark red soft nodules were also observed (Fig. 1B and C). The spleen showed prominent caseous spheroidal masses of varying size from 0.5 cm to hazel nut (Fig. ID). The liver was focally involved with the formation of large caseated nodules (Fig. IE). Similar lesions were also observed in the kidneys but were smaller and sporadic.

Generally, typical histological characteristics of tuberculous lesions with the difference that Langhans giant cells were very rare and there was an increasing tendency for fibrous tissues proliferation. Early lesions started as aggregation of epithelioid cells surrounded by a large number of lymphocytes Fig. 2AE. This was followed
Fig. (1a): Lung showing numerous tubercles of varying size and age scattered on the surface.

Fig. (1b): Diaphragmatic pleura showing numerous raised plaques and grape-like nodules.
Fig. (1c): Discrete miliary tubercles attached to the pleura of the thoracic wall.

Fig. (1d): Spleen prominent caseous spheroidal masses of varying size.
Fig. (1e): Liver showing caseated nodules.

Fig. (2a): Lung showing an early tuberculous reaction consisting of epithelioid cells (e) surrounded by lymphocytes (h and e x33).
Fig. (2b) : Progressing tuberculous nodule showing central caseation (h and e x33).

Fig. (2c) : An old tubercle nodule in which caseation extended to involve large area, become calcified (c) and showed a peripheral intense lymphocytic cell infiltration (h and e x132).
Fig. (2d): Margin of an old tubercle showing a single giant cell (arrow), mononuclear cells mainly lymphocytes, intact epithelioid cells and fibrocytes (h and e x66).

Fig. (2e): Spleen showing prominent fibrous reaction (f) surrounding a central core of caseation and calcification (h and e x132).
Fig. (2f): Pleural grape like nodule showing diffuse caseation necrosis, central calcification and a peripheral thick dense fibrous capsule (fc) sh owed scant lymphocytes (h and e, x132).

Discussion

The ELISA-PPD described herein, using protein A labelled with horseradish peroxidase conjugate as a substitute for the specific anti-camel IgG conjugate, can be applied in the detection of anti-tuberculosis antibodies in dromedary camels. Investigation of 107 serum samples of blindly selected camels tested by ELISA could detect 9 cases as positives with 100% sensitivity but by comparison with bacteriological findings the specificity of the test was low as the true positive were only 3 camels from which *M. bovis* and *M. Africanum* were isolated, but the test could pick up 7 cases as positive where *C. pseudotuberculosis* and MOTT were isolated. These results of low isolation of *M. bovis* demonstrate that the skin reactions of the necropsied positive reactor by present interpretation key can be attributed to the non-spe
pecific sensitization of these animals and this problem can be solved by using new recommended interpretation of tuberculin test to increase the specificity of skin test. The isolation of *M. bovis* from suspected tuberculous lesions of slaughtered camels in the present investigation coincide with the result of many investigators who failed to isolate Mycobacteria from tuberculous like lesions. But, the isolated organisms were *Corynebacterium, Staphylococcus, Streptococcus, Citrobacter* and *Escherichia coli*. For confirmation of ELISA results, a comparison was carried out with the cervical skin reactions by using mammalian and bovine tuberculins on the same animals but interpretation of the degree of increase in skin thickness was evaluated by two systems of standardization. Results in skin thickness was evaluated by two systems of standardizations. Results in the specificity of mammalian PPD was 73.1% only and increased to 95.2% by using the new standard key and similar results observed with bovine PPD in which the specificity percent increased from 85.6% to 99%. These results confirm those obtained in a previous study, which recommended a new standard key for the diagnosis of tuberculosis in camels. The percent of specificity in ELISA (94.2%) was nearer to the percents of tuberculin tests evaluated by the newly standard keys.

The same correlation has been reported during investigation in camels. The high specificity of ELISA as a serological test for screening of dromedary camels during the programs of controlling tuberculosis and positive animals must be tested with tuberculin test using bovine PPD and skin readings must be evaluated with the new recommended standard key. In the first step of a control program, a method with good sensitivity is required and little reduction in specificity is acceptable. As diagnosis of tuberculosis in slaughtered animals depends mainly on post-mortem and histopathological investigations and since information is very scanty in literature, a full description of the gross and microscopic tuberculous lesions in tissues collected from experimentally infected camels with *M. bovis* was made. It was observed that histopathological features of fibrous tissue with no exudative reaction and few Langhan's giant cells. The same histopathological findings coincide with those described in bacterian camels.

The histopathological features are in contrast to lesions observed in cattle where the centre has a caseous necrosis, usually with some calcification with a boundary of epithelioid cells and some of which form multinucleated giant cells and a few to numerous lymphocytes and neutrophils. An outer border of fibrous connective tissue is usually present, giving the lesion a focal appearance and providing encapsulation to some extent.

In conclusion, the results of the present investigation necessitate the application of newly standard interpretation key for single intradermal tuberculin by using bovine tuberculin under the Egyptian conditions in addition to adopting serological tests such as ELISA due to high sensitivity and specificity in order to confirm diagnosis of bovine tuberculosis.

**Acknowledgement**

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PRATIQUE VETERINAIRE PRIVEE RURALE AU TOGO :
APPRCIATION SOCIO-ECONOMIQUE DE SA VIABILITE.

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PRIVATE RURAL VETERINARY PRACTICE IN TOGO : ASSESSMENT OF SOCIO-
ECONOMIC VIABILITY

Summary

In most West-African countries, governments are in the process of privatising state veterinary services in order to restrain their public sector expenses. In Togo, this has led to an emerging private veterinary sector in rural areas. From the very beginning the animal trypanosomosis control project has encouraged and counselled these young private vets in their attempts to impose themselves in this surrounding which was not familiar with paying animal health services. As has been shown recently, private vets, through a nation-wide extension campaign and the enhanced availability of the basic animal health services they offer, have had a major impact on disease prevalence in Togo. In order to ensure sustainability and continued availability of these services, a socio-economic study was set up in order to identify social, structural and economic constraints to the viability of rural private veterinary practice in the mid and long term. From the study, it appears that 8 out of 10 private practices included in the study, are both financially and structurally sound enterprises with prospects for substantial growth in the years to come. Private vets in rural areas today cover approximately 50% of agricultural and livestock production areas in Togo. The major constraint would appear to be the limited access to credit when financial turnovers increase to such proportions that self-finance becomes insufficient. Another possible cause for worry is the reliance on trypanocide sales to nomadic herdsman crossing Togo, which is a typical feature of animal husbandry in Togo, but which is also subject to social and political controversy.

Résumé

La plupart des pays Ouest-Africains se sont engagés dans le processus de libéralisation du secteur vétérinaire afin de mieux maîtriser leurs dépenses publiques. Ainsi, au Togo, l'on a pu observer l'émergence d'un secteur vétérinaire privé dans le milieu rural. Dès son début, le Projet de lutte contre la trypanosomose animale a encouragé et conseillé ses jeunes vétérinaires privés dans leurs tentatives de s'imposer dans cet environnement jusqu'alors hostile à tout service payant. Comme vient de le démontrer le Projet, les vétérinaires privés semblent avoir eu –à travers une campagne nationale de vulgarisation et la disponibilité des services privés de santé animale de base- un impact considérable sur la prévalence de la trypanosomose animale africaine au Togo. Dans l’objectif de s’assurer de la pérennité et de la disponibilité de ces services dans l’avenir, une étude socio-économique a été initiée afin de recenser les contraintes sociales, structurelles et économiques de la viabilité de l’exercice privé en milieu rural à moyen et long terme. De l’étude, il ressort que sur 10 cabinets vétérinaires analysés, 8 peuvent être considérés comme étant des entreprises saines du point de vue aussi bien économique que structurel, ayant des perspectives de croissance considérables dans les années à venir. Les vétérinaires privés ruraux couvrent aujourd’hui environ 50% des zones agricoles (y compris d’élevage) au Togo. Les contraintes majeures qui ressortent de cette étude sont l’accès limité et complexe au crédit alors que leurs chiffres d’affaire prennent une telle envergure que la capacité d’auto-financement se révèle insuffisante. Une autre inquiétude découle de la dépendance de la majorité des cabinets des ventes de trypanocides aux transhumants qui traversent le Togo, une caractéristique typique de l’élevage au Togo, mais sujette à de multiples controverses sociales et politiques.

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Introduction

Dans la vague des crises économiques qui ont frappé les pays du tiers monde au cours des années '80 et '90 et qui ont contribué à l'hyper-endettement et à l'effondrement des systèmes fiscaux, la communauté internationale a jugé bon de venir en aide avec des systèmes de réforme ciblés sur le remboursement des dettes en vue d'en octroyer d'autres. Les réformes ou ajustements structurels des économies nationales étaient basées sur certains principes : l'élimination des subventions, la diminution du déficit budgétaire national, l'élimination de la tarification centralisée et la privatisation des entreprises étatiques. Dans la perspective de transférer des productions et services du secteur public au secteur privé, les bailleurs de fonds ont toujours argumenté que dans la plupart de ces secteurs le privé fournit de meilleures performances à moindre coût.

Ainsi, au cours des dix dernières années ou plus, de nombreux pays Africains en voie de développement ont subi d'une manière ou d'une autre des programmes d'ajustement structurel, dont une des composantes majeures est la privatisation (1). En 1987, la Banque Mondiale a recommandé d'inclure le principe de recouvrement des coûts dans un programme de financement des prestations de services de santé par le secteur public dans les pays en développement. "l'Initiative de Bamako" est un modèle de partage des coûts lancé en 1987 par les Ministres africains de la Santé en vue de faire participer les communautés à la gestion et au financement des soins de santé. Un principe important de cette initiative est que chacun doit payer au moins quelque chose et que les fonds ainsi collectés seront utilisés pour améliorer les services de santé primaires (2).

La crise économique et institutionnelle dans de nombreux pays africains a marqué le début de la détérioration de la qualité des services vétérinaires avec comme conséquences notamment la recrudescence de la peste bovine et la PPCB (3). Le désengagement de l'Etat à travers les politiques d'ajustement structural dans le secteur élevage s'est donc manifesté essentiellement par la libéralisation des services vétérinaires (4) (5).

La première étape de ce processus a été la nécessité de redéfinir les nouvelles missions de l'Etat : un rôle exclusif dans l'élaboration, l'orientation et le contrôle des politiques nationales et un rôle non-exclusif (vulgarisation, ventes des intrants, conseils, services...) pouvant être exercés soit par l'Etat, soit par des opérateurs privés (vétérinaires privés, autres acteurs de la santé animale, organisations professionnelles paysannes...) encouragés par l'Etat.

privés au Togo dont 4 en tant que docteurs vétérinaires pharmaciens ; la plupart de ces vétérinaires sont installés en zone urbaine principalement dans la capitale." Depuis le début, le Projet de lutte contre la trypanosomose animale (PLTA) ainsi que Vétérinaires Sans Frontières (VSF) ont encouragé et conseillé ces jeunes vétérinaires privés dans leurs tentatives de s'imposer dans cet environnement jusqu' alors hostile à tout service payant (9). Comme l'a pu démontrer le PLTA, les vétérinaires privés semblent avoir eu -à travers la disponibilité de services privés de santé animale de base- un impact considérable sur la santé animale au Togo (10). Dans l'objectif de s'assurer de la pérennité et de la disponibilité de ces services dans l'avenir, une étude socio-économique a été initiée afin de recenser les contraintes sociales, structurelles et économiques de la viabilité de l'exercice privé en milieu rural à moyen et long terme (11).

**Objectif de l'étude**

L'objectif de l'étude est de clarifier les perspectives de survie et de rentabilité à moyen terme des pratiques vétérinaires privés en milieu rural au Togo. Cette étude ne concerne donc que les vétérinaires privés réellement "privés" ne bénéficiant d'aucun appui ou salaire institutionnel et/ ou systématique ; en outre, elle ne concerne que des vétérinaires privés exerçant leur métier dans le milieu rural, c'est-à-dire en dehors de la zone péri-urbaine et urbaine de la capitale Lomé. Enfin, elle ne concerne pas tous les vétérinaires privés en pratique rurale aujourd'hui, mais essentiellement les onze premiers vétérinaires privés ayant saisi l'occasion de s'installer en pratique privée et ayant dépassé le stade de démarrage de leurs entreprises.

**Matériel et méthodes utilisés**

L'étude a été conçue en étroite collaboration avec les 11 vétérinaires privés concernés. D'une part, les réunions des vétérinaires privés exerçant en milieu rural que le Projet et VSF organisaient au cours de 1997 et 1998 ont permis d'harmoniser les points de vue des vétérinaires privés sur la conduite de l'étude. En outre, les cours en gestion et comptabilité des cabinets vétérinaires privés dont ont bénéficié les vétérinaires privés ont permis de "standardiser" la comptabilité des cabinets vétérinaires. Une série de visites des cabinets vétérinaires a permis aux redacteurs de cette étude de se faire une idée des paramètres socio-économiques à prendre en compte dans le cadre d'une telle étude. L'étude, qui s'est déroulée en 1998, inclut donc d'une part le recensement des paramètres étroitement financiers et comptables permettant d'apprécier " l'état de santé " des différents cabinets privés ; d'autre part, une large attention est accordée aux aspects socio-professionnels qui peuvent améliorer, maintenir ou, au contraire, rendre difficiles les perspectives de survie à moyen terme.

**QUESTIONNAIRE SOCIO-ÉCONOMIQUE**

Un questionnaire socio-économique ciblé sur la récolte des données non-financières et liées au démarrage du cabinet et à son fonctionnement actuel a été conçu par l'équipe mixte VSF – PLTA en accord avec les vétérinaires privés. Le questionnaire -après un premier essai qui s'était relevé satisfaisant- a été distribué aux 11 vétérinaires privés des 10 cabinets vétérinaires. Le questionnaire couvre globalement les aspects suivants :

- L'identification du vétérinaire privé :
  Situation familiale, Profil professionnel,
Motivations
- La structure du cabinet : Structure légale du cabinet, Organisation du travail, Employés, Infrastructures, Equipement
- La collaboration avec d'autres institutions
- La zone d'activité et les filières dominantes : Cartographie, Estimation des visites de terrain et accueils en cabinet, Répartition de l'importance relative et absolue des différentes filières
- Les visites : Estimation de la fréquence des visites en milieu rural, Recensement des autres activités du vétérinaire privé
- Les réseaux : La concurrence, Les fournisseurs

**ANALYSE FINANCIERE DU CABINET VETERINAIRE PRIVE**

Quelques données sommaires de ce questionnaire ont servi de point de départ pour une mission technique de 10 jours par un spécialiste-comptable, qui a permis de faire un diagnostic détaillé de l'état de santé financier et comptable de chaque cabinet vétérinaire : par rapport à son démarrage, par rapport à l'état actuel et par rapport aux perspectives pour les trois années à venir (1999-2001). La première approche en termes d'analyse d'un cabinet, qui est en fait une PME (12), est de se poser un certain nombre de questions :

- Comment évolue la rentabilité et pourquoi ?
- Quelle trésorerie potentielle a-t-elle dégagé?
- Le cabinet vétérinaire est-il solvable?
- Le financement est-il adapté?

Après cette analyse sommaire, une analyse plus détaillée devra être faite en suivant le canevas ci-dessous :

**Diagnostic opérationnel : de l'activité à la trésorerie (étude du Compte de Résultat)**

- Détermination du chiffre d'affaire (CA) et validation de sa prévision : étude des produits demandés par les éleveurs et la fiabilité de la filière de distribution, étude des contraintes d'exploitation, situation du marché, identification des types de clientèle pouvant influencer l'évolution du CA;
- Analyse de quelques éléments des soldes intermédiaires de gestion : la formation de la valeur ajoutée (VA) par l'activité en elle-même, les consommations intermédiaires, la formation de l'excédent brut d'exploitation (EBE), l'analyse des charges du personnel, l'analyse des impôts, taxes et versements assimilés dus, la capacité d'autofinancement (CAF), l'analyse du niveau de la CAF (significative, est-ce qu'il y a lieu de l'affecter, est-ce que le niveau de la CAF peut financer la croissance du cabinet ?) et l'excédent de trésorerie d'exploitation (ETE).

**Diagnostic financier : de la trésorerie à la stratégie à long terme de la structure (Etude du Bilan)**

- Analyse critique du bilan pluriannuel : évaluation du niveau des immobilisations, évaluation des stocks, niveau de couverture du besoin en fonds de roulement (FR), rotations et délais des produits;
- Analyse de l'évolution et du niveau de la solvabilité : évolution du risque d'insolvabilité, évolution des fonds propres, flexibilité des contraintes (facility de cession d'éléments d'actifs, facility d'augmentation des fonds propres en cas de besoin).
- Analyse dynamique des besoins de financement : besoins d'investissement et besoins d'exploitation en prévision, besoins
réels au cours des exercices passés, niveau actuel des besoins.

Diagnostic prévisionnel et stratégique

- Aspect opérationnel : Critique des résultats prévisionnels et analyse des résultats prévisionnels;
- Aspects financiers : Vérification des données financières, est-ce que les prévisions en matière de financement et de trésorerie répondent bien aux besoins réels du cabinet?
- Aspects stratégiques : Les perspectives de croissance à long et moyen terme.
  Vérifier les stratégies de croissance possibles par un accroissement des parts de marchés de l'activité, une extension des activités vers des zones plus porteuses, une instauration d'une bonne campagne de sensibilisation et de formation ou encore une diversification de son activité. Vérifier avec quels moyens financiers ces stratégies peuvent se réaliser : un renforcement des fonds propres, un endettement à long terme ou une association avec d'autres partenaires ?

Résultats

Les 11 vétérinaires privés – tous des hommes - travaillent dans 10 cabinets vétérinaires privés ; deux d’entre eux se sont associés en vue de rentabiliser le capital de démarrage et de mettre en commun les moyens d’exploitation lors du démarrage. Les dix cabinets vétérinaires privés se trouvent tous en milieu rural, c’est-à-dire en dehors de la zone péri-urbaine de la capitale Lomé. La plupart d’entre eux se trouvent néanmoins dans des centres régionaux comme les chefs-lieux des régions administratives ou les chefs-lieux des préfectures. L’on peut estimer l’ensemble des zones d’activités de ces dix cabinets vétérinaires privés à plus de 50% des zones économiques du point de vue agricole (au sens large). Figure 1. La répartition des cabinets vétérinaires et leurs zones d’activités ne sont définies que par la répartition et la densité du gros bétail au Togo. Au contraire, la répartition spatiale semble être liée à l’interface densité humaine et intensité agricole. Ce paramètre reflète probablement mieux la présence et l’importance des autres formes d’élevage, en particulier les élevages des espèces à cycle court, comme la volaille (poulets et pintades), les petits ruminants (ovins et caprins) et les porcins.

Au moment de l’étude, l’âge moyen des vétérinaires privés était de 33,6 ans. Les vétérinaires privés ont en moyenne 5 personnes à leur charge avec en moyenne un enfant par ménage (Tableau 1).

Le pays ne disposant pas d’école vétérinaire, tous les vétérinaires ont été formés à l’étranger. La majorité des vétérinaires privés concernés par la présente étude ont été formés au Sénégal (Université Cheikh Anta Diop de Dakar), viennent ensuite l’Ukraine et les pays du Maghreb. Cette « expatriation » a été permise grâce à une politique d’octroi de bourses nationales ou de coopération entre le Togo et les autres pays. Les 11 vétérinaires concernés par l’étude ont été diplômés en majorité entre 1993 et 1994 (Figure 2). Il s’écoule en moyenne deux ans entre l’année d’obtention du diplôme et l’installation du vétérinaire privé. Plusieurs raisons expliquent ce décalage : une formation complémentaire post-universitaire souvent orientée vers les notions de gestion des entreprises ou d’informatique, une expérience professionnelle après la formation post-universitaire effectuée principalement à la clinique vétérinaire publique de Lomé sous forme de stage d’imprégnation. Seul un des vétérinaires a commencé ses activités par l’élevage après son retour au pays.

Les raisons du choix de l’exercice en
Figure 1. Zones d’activité des dix (10) vétérinaires privés en clientèle rurale.

Légende:

Zone d’intervention des cabinets vétérinaires privés ruraux

Limite administrative de préfecture

Chef-lieu de préfecture

Lomé (capitale)
Figure 2. Année d'obtention du diplôme universitaire en médecine vétérinaire.

Tableau 1. Situation et responsabilité familiale des vétérinaires privés (11).

<table>
<thead>
<tr>
<th>Personnes à charge</th>
<th>Enfants</th>
<th>Enfants à charge</th>
<th>Taille du ménage</th>
<th>Personnes &lt; 6 ans</th>
<th>Personnes 6 - 18 ans</th>
<th>Personnes &gt; 18 ans à charge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moyenne</td>
<td>5.18</td>
<td>0.91</td>
<td>1.73</td>
<td>4.09</td>
<td>0.82</td>
<td>1.36</td>
</tr>
<tr>
<td>Maximum</td>
<td>12</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>
clientèle privé sont multiples. La principale raison évoquée est la volonté d’être indépendant, le non-accès à la fonction publique étant la deuxième raison. La majorité des cabinets vétérinaires ont eu une autorisation d’ouverture sous la dénomination "pharmacie vétérinaire". La loi fait une distinction entre les pharmacies vétérinaires dont l’activité principale est la vente des médicaments et autres intrants vétérinaires et les cliniques dont l’activité se réduit aux soins vétérinaires. Le cas du Togo était typiquement original sur ce point, le souci du législateur ayant vraisemblablement été de permettre aux futurs vétérinaires de disposer d’un minimum d’activités commerciales (partagées) à travers cette distinction. Dans la pratique, elle n’a jamais été respectée.

Juridiquement, les cabinets vétérinaires étudiés sont principalement constitués sous la forme de sociétés de personnes. Un des cabinets est une association de deux confrères dont la forme correspond plutôt à un groupement d’intérêt économique. Au moment où cette enquête se déroulait, un des cabinets est passé à une société anonyme à responsabilité limitée (S.A.R.L.). Ce changement a accompagné l’activité même de ce cabinet qui a aujourd’hui plutôt un caractère de grossiste. Le coût du démarrage des activités est en moyenne de 1.66 million FCFA (2.500 €), soit environ l’équivalent de 13 mois de salaire pour un collègue recruté à la fonction publique (Figure 3). Le contexte socio-économique dans lequel s’ouvrent la plupart de ces cabinets est particulièrement défavorable. La majorité des cabinets ont démarré leurs activités en 1995 au moment où le pays se trouvait encore dans une situation particulièrement difficile dont l’origine est double : la dévaluation du FCFA en janvier 1994 et la gestion du lourd passif des événements du début des années ’90 (Figure 4). Les vétérinaires ont dû par eux-mêmes trouver l’argent nécessaire pour cela. Ils n’ont pas eu la chance de leurs collègues Sénégalais, Maliens ou Burkinabé qui ont bénéficié de l’important soutien du programme PARC.

Le coût financier au démarrage des activités est en moyenne réparti comme suit :
- 63% d’apport strictement personnel ;
- 22% de dettes à court terme ;
- 11% de dettes à moyen et à long terme ;
- 4% d’apport d’origine diverse (famille, amis...).

Les dépenses au départ concernent essentiellement l’achat du matériel d’exploitation, la réfection des locaux professionnels, le loyer et, pour certains, l’achat d’une motocyclette. Cette dernière est pourtant capitale pour assurer les tournées dans les villages. Le taux d’équipement le plus élevé des cabinets au moment de l’étude concerne l’équipement roulant. Tous les cabinets sont équipés de motocyclettes et/ou de voitures. Outre son moindre coût, la motocyclette est souvent préférée à la voiture car elle permet d’atteindre des zones souvent d’accès difficile, rendant ainsi moins cher le coût d’un déplacement. Par contre, moins de 20% de ces véhicules sont assurés. Seul un cabinet (à cause de son emplacement) ne possède pas d’électricité. Figure 5.

Le personnel employé dans les 10 cabinets varie d’un nombre allant de 0 à 6. Sur les 9 cabinets ayant des employés, 6 ont un personnel qualifié. Ce sont le plus souvent d’anciens agents d’élevage des services ou des projets d’élevage (Figure 6).

D’une manière générale, la vente des produits vétérinaires (vendus au cabinet ou lors des tournées) est financièrement plus importante que les prestations cliniques proprement dites dans la réalisation du chiffre d’affaire du cabinet. Les antiparasitaires et notamment les
trypanocides sont en tête des produits vendus (Tableau 2).

La clientèle des cabinets vétérinaires est principalement constituée de

**Tableau 2.** Pourcentage des ventes de trypanocides par rapport à l’ensemble des ventes de produits vétérinaires (en ordre décroissant de pourcentage).

<table>
<thead>
<tr>
<th>Cabinet n°</th>
<th>Type de cabinet</th>
<th>Trypanocides (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Clinique</td>
<td>77%</td>
</tr>
<tr>
<td>5.</td>
<td>Pharmacie</td>
<td>65%</td>
</tr>
<tr>
<td>3.</td>
<td>Clinique</td>
<td>64%</td>
</tr>
<tr>
<td>9.</td>
<td>Pharmacie</td>
<td>63%</td>
</tr>
<tr>
<td>1.</td>
<td>Pharmacie</td>
<td>60%</td>
</tr>
<tr>
<td>7.</td>
<td>Pharmacie</td>
<td>60%</td>
</tr>
<tr>
<td>4.</td>
<td>Clinique</td>
<td>59%</td>
</tr>
<tr>
<td>6.</td>
<td>Pharmacie</td>
<td>45%</td>
</tr>
<tr>
<td>8.</td>
<td>Pharmacie</td>
<td>14%</td>
</tr>
<tr>
<td>10.</td>
<td>Clinique</td>
<td>11%</td>
</tr>
</tbody>
</table>

**Figure 3.** Nombre cumulatif de vétérinaires privés installés entre 1990 et 1998.
propriétaires de gros bétail. Ce sont les transhumants, les propriétaires de bœufs de trait et de troupeaux sédentaires. La volaille traditionnelle vient en deuxième position même si les effectifs sont de petite taille (en moyenne de 50 têtes/paysan). Cette importance est liée aux activités des Auxiliaires Villageois d’Elevage (AVE) collaborant avec ces cabinets et qui achètent les vaccins contre la maladie de Newcastle (pour environ 17 millions FCFA/an, 26.000 €/an), les produits antiparasitaires et les produits antibiotiques et vitaminés (Fig. 7 et 8).

La moyenne des sorties effectuées par cabinet et par jour ouvrable a été calculée sur l’estimation des sorties effectuées sur l’année 1998. Cette moyenne est importante car elle permet d’apprécier le degré d’implication du cabinet dans les activités directement réalisées auprès des éleveurs malgré la double contrainte (logistique et économique) évoquée ci-dessus. Chaque cabinet effectue en moyenne une sortie par jour ouvrable (Figure 9). Ce chiffre prend en compte en moyenne les trois personnes actives au cabinet (le vétérinaire et ses deux agents).
Figure 5. Équipement des cabinets vétérinaires classé en fonction de la fréquence.
Figure 6. Employés qualifiés et non-qualifiés des différents cabinets.

Légende:
- **Employés qualifiés**
- **Employés non-qualifiés**

Figure 7. Estimation de l'importance des différentes filières dans les accueils en cabinet (pharmacie ou clinique). Un score de 4 est attribué à une fréquence élevée. Représentation : moyenne et écart type.
L’augmentation de ce nombre encore faible est fonction de la demande car c’est l’éleveur qui prend en charge le coût du déplacement (dans l’hypothèse que le vétérinaire aura les moyens logistiques lui permettant de répondre à cette demande). Le rôle du vétérinaire privé dans l’appui-conseil, l’épidémiosurveillance, le suivi des élevages s’en trouve fortement limité.

La marge appliquée sur les ventes de médicaments dépend du volume de ventes des médicaments (les cabinets ayant un faible volume de vente ont tendance à le compenser par une forte marge), des relations qu’entretient le cabinet avec son fournisseur dans la négociation des crédits-fournisseurs et de la politique commerciale du cabinet. Cette marge varie entre 12 et 66% (Figure 10).

Figure 9. Comparaison du nombre estimatif moyen de sorties par jour ouvrable.

Figure 10. Marges bénéficiaires sur ventes (%).
Figure 11. Comparaison des principaux paramètres financiers pour les 10 cabinets vétérinaires (1998).

Légende:
- **Chiffre d'affaires (CA)**
- **Excédent brut d'exploitation (EBE)**
- **EBE / CA**

rapport aux stratégies de développement qu'ils envisagent pour leur cabinet. Dans cette perspective, on remarque que seuls 2 cabinets ne pourront pas atteindre le seuil de rentabilité fixé à 15% au terme de cette échéance. En 1999, 7 cabinets sur dix devraient atteindre cet objectif contre 4 seulement en 1998. L'évolution prévisionnelle spectaculaire du cabinet code n° 3 ayant tendance à masquer les évolutions des autres cabinets dans la figure 12, les mêmes paramètres ont été repris dans la figure 13 hormis ce cabinet n° 3 pour une meilleure lecture des résultats.

Dans l'analyse comptable, les charges salariales ont été prises en compte dans les bilans et comptes des résultats. Il convient de préciser qu'il s'agit uniquement du salaire du vétérinaire privé et des indemnités de ses employés. Ces indemnités sont souvent dérisoires et varient entre 10.000 et 30.000 FCFA par mois (15 - 45 €). Un cabinet vétérinaire réalisait en 1998 un résultat net moyen d'environ 1,5 million FCFA (2.280 €). En tenant compte d'un salaire mensuel moyen de 91.000 FCFA par mois et par vétérinaire (140 €) incorporé au bilan de l'entreprise et déduit du revenu brut, un vétérinaire privé pourrait ainsi obtenir en moyenne un revenu mensuel (pour lui-même et ses employés) de près de 236.000 FCFA (359 €).
Le recensement des activités secondaires, rémunératrices liées à l'élevage ou non, laisse clairement apparaître que la majorité des vétérinaires ont une activité secondaire et que celle-ci est principalement liée directement ou indirectement à l'exercice de la profession vétérinaire (commerce de bétail, élevage, boucherie, etc.) Figure 14. Les activités secondaires non-rémunératrices recensées suggèrent que l'exercice de la profession vétérinaire constitue un certain prestige social qui se retrouve dans les fonctions qu'ils assument au sein des différentes organisations communautaires dont ils sont membres (mouvement religieux, association sportive, etc.).

Des 10 cabinets concernés par l'étude, seuls 2 ne collaborent pas avec les AVE. Les raisons sont pour l'un l'absence d'AVE dans la zone d'action et pour l'autre une organisation de son travail au quotidien qui ne lui en laisse pas le temps. Aucun des 11 vétérinaires ne considère ces AVE comme des concurrents. Si au début l'AVE a été considéré comme tel, la volonté des vétérinaires privés en clientèle rurale est de "contrôler" ce réseau afin d'accroître leurs activités (vente de vaccins contre la maladie de Newcastle, d'anti-parasitaires externes et internes, santé des paysans et santé animale...) en milieu rural est clairement affichée. Les cabinets vétérinaires ne peuvent cependant pas supporter le coût des formations, des recyclages et du suivi des AVE. Ils sont néanmoins systématiquement impliqués dans ces actions par VSF/Togo.

Parmi les structures avec lesquelles les cabinets vétérinaires entretiennent des relations privilégiées, les trois grands projets d'élevage figurent en première place : le Projet régional de lutte contre la trypanosomose animale (principalement gros bétail), Vétérinaires Sans Frontières (principalement volaille) et le Programme National Petit Elevage (principalement petits ruminants et porcins). Si ceci paraît logique quand on sait que ces trois projets ont associé les vétérinaires privés à leurs activités opérationnelles, il y a lieu de se rassurer que cette collaboration n'entrave pas l'indépendance financière des cabinets vétérinaires. Le partenariat représente la forme de collaboration la plus courante entre les cabinets vétérinaires d'une part, le projet PLTA et VSF d'autre part. Il s'agit d'actions conjointement entreprises dans l'intérêt de chaque partie avec la mise en commun de moyens pour atteindre un objectif (sensibilisation, formations diverses, enquêtes, études conjointes). La prestation de service correspond à la réalisation d'un travail précis, limité dans le temps pour lequel le vétérinaire est rémunéré totalement en compensation du temps qu'il y consacre ( vulgarisation, suivi des AVE,...). Elle prend souvent la forme d'un contrat écrit et signé des deux parties. La limite entre les deux types de collaboration est cependant quelques fois difficile à saisir. Le mandat sanitaire est une prestation de service d'une nature différente puisqu'il fait l'objet d'une sollicitation des autorités dans l'intérêt public. Avec le PNPE, la prestation de service se manifestait par l'implication des vétérinaires privés aux campagnes de vaccination contre la peste des petits ruminants.

L'environnement dans lequel évolue un cabinet vétérinaire est constitué de plusieurs acteurs dont nombreux sont des concurrents en soins vétérinaires ou pour la vente des médicaments. On remarque que les acteurs les plus cités sont ceux qui se livrent à une activité de vente de médicaments (soit de manière légale en ce qui concerne les pharmacies publiques, soit illégalement en ce qui concerne les dépôts des grossistes et les vendeurs ambulants). On peut encore remarquer la trop fréquente présence des structures publiques dans l'environnement vétérinaire.

Figure 14. Autres activités rémunératrices liées à l'élevage.
Discussion et conclusion

En Afrique de l'Ouest aujourd'hui, la réalité est encore très éloignée de l'idéal ou l'optimal. L'état d'avancement dans ce 'partage des pouvoirs' entre les pouvoirs publics et privés est peu satisfaisant. Il y a en réalité un troisième chemin 'mixte' et ceci selon plusieurs perspectives : premièrement la 'cohabitation' des secteurs public et privé dans les mêmes domaines, par exemple en réalisant un partage géographique des zones d'intervention pour un service clinique (13); deuxièmement la sous-traitance au secteur privé des tâches ressortant de la responsabilité du secteur public (le mandat sanitaire) et troisièmement l'intervention de ce qu'on appelle maintenant le "troisième secteur" (14) (15) c'est-à-dire l'ensemble des ONG, coopératives de producteurs, groupements communautaires, associations d'intérêt qui peuvent fournir des prestations qu'on pourrait qualifier de 'privées, mais souvent dans un but non-lucratif, donc plutôt 'publiques'. Ils peuvent être financés par les membres (coopératives, associations, groupements) ou par des tiers (ONG).

Les 'acteurs' ne sont pas simplement les vétérinaires du secteur public et les vétérinaires privés; la privatisation a marqué le début d'une multiplication d'intervenants vétérinaires qui ont profité (au bon sens ou au mauvais sens du mot) du vide législatif qui existe encore aujourd'hui dans beaucoup de pays par rapport au secteur vétérinaire privé. L'on distingue d'une part les intervenants 'authorisés' (vétérinaires privés, zootechniciens, techniciens d'élevage, auxiliaires d'élevage...) et d'autre part les 'clandestins' (vendeurs ambulants de médicaments, commerçants divers...) (16) (17). Si l'évidence du caractère illégal des seconds ne fait aucun doute, beaucoup d'acteurs autorisés cités ci-dessus évoluent souvent dans un contexte informel qui dépasse largement le cadre légal de leurs attributions. Le succès de ces aspects frauduleux auprès des éleveurs est malheureusement la traduction d'un désengagement encore fragile. Les États de la sous-région doivent trouver le point d'équilibre entre le contrôle et la répression, d'une part, et le souci de privatiser sans marginaliser, d'autre part. Le PARC, les ONG, les multiples projets de l'État ainsi que les laboratoires de pharmacies vétérinaires des pays du Nord ont contribué à l'émergence du secteur privé dans la sous-région. Malheureusement, l'harmonisation des politiques de désengagement fait encore défaut. Si dans certains pays le secteur privé a du mal à démarrer, d'autres pays sont confrontés à une libéralisation anarchique avec une multitude d'acteurs privés qui s'installent un peu partout. Dans plusieurs pays, le problème de l'installation des vétérinaires privés se pose déjà en termes d'excédent d'offre par rapport à la demande de la part des éleveurs. Les vétérinaires privés sont en concurrence non seulement avec les services vétérinaires publics, mais aussi entre eux et surtout avec les nombreux grossistes urbains qui improvisent des succursales dans les centres ruraux à l'intérieur du pays (18). Tambi E.N. et al. (19) signalent que les vétérinaires privés au Kenya se sentent plus menacés par les pharmaciens et grossistes que par les vétérinaires publics et les autres agents de l'État qu'ils considèrent plutôt comme complémentaires à leur pratique. Ce qui se confirme aussi au Togo : une des contraintes majeures à l'exercice privé reste la concurrence déloyale d'un certain nombre d'acteurs, d'une part des vendeurs ambulants, non-qualifiés et non-agréés, de produits vétérinaires, d'autre part des grossistes urbains qui implantent des dépôts de vente en détail de produits vétérinaires à l'intérieur du pays, et enfin
la concurrence institutionnelle due aux retards accusés dans le processus de désengagement des services vétérinaires publics (les pharmacies SAB, certains services vétérinaires, certains projets de l'Etat, etc.). Les vétérinaires sont par ailleurs peu connus des paysans ; la confusion généralisée sur le terme "vétérinaire" masque leur légitimité de compétence par rapport à leurs concurrents. Les problèmes de concurrence déloyale et par conséquent de survie du cabinet privé sont encore accentués par l'ambiguïté qui existe entre le discours officiel, d'une part, et la réalité du désengagement de l'Etat et de la privatisation ainsi que des nouvelles structures à mettre en place, d'autre part. L'absence de textes juridiques régissant la pratique vétérinaire privée et le mandat sanitaire contribuent à entretenir ce flou administratif.

Mais il n'y a pas que les contraintes externes ; de nombreux auteurs ont signalé le manque de rigueur, d'éthique et de professionnalisme de la part des vétérinaires privés mêmes, ce qui contribue à la confusion des éleveurs pour savoir qui est et qui n'est pas vétérinaire. Il est vrai que les différences ne sont pas toujours claires. Thomé O. et al. (16) parlent d'une approche "marchande et médicamenteuse de la santé animale", et dénoncent le transfert du secteur public au secteur privé en absence de toute programmation. Ainsi, beaucoup de services vétérinaires publics sont actuellement remplacés par des structures privées dont les compétences sont loin d'être claires. Les vétérinaires privés, pourtant les mieux qualifiés pour intervenir auprès des éleveurs, se concentrent sur la vente des produits vétérinaires dans leurs cabinets (urbains) et laissent les activités de terrain aux 'soins' des auxiliaires qu'ils engagent (20). Au Kenya, on a constaté que le manque de professionnalisme dans la présentation personnelle (vestimentaire), l'équipement, les moyens de diagnostic, les moyens de transport et surtout l'état et l'apparence du cabinet même, contribuent beaucoup à la mauvaise réputation de certains vétérinaires privés, au détriment de la réputation de la profession en général (19). Selon notre étude, le bilan au Togo semblerait être plutôt positif. Malgré le fait d'un nombre encore insuffisant de déplacements sur le terrain par rapport aux accueils au cabinet (Figure 9), la présence des vétérinaires privés dans le milieu rural est efficace en termes d'impact sur la santé animale. Les vétérinaires sont bien conscients qu'ils valorisent mieux leurs compétences en se déplaçant dans les troupeaux qu'en se limitant à la délivrance de médicaments au cabinet, ce qui favorise la concurrence avec les nombreux vendeurs de médicaments moins qualifiés qu'eux. En revanche, on note une dépendance trop prononcée du chiffre d'affaire par rapport aux ventes de trypanocides (jusqu'à 70% du CA) Tableau 2. Ceux-ci sont éculés dans les troupeaux de ruminants locaux et sédentaires, mais surtout dans les troupeaux de bétail transhumant. Ce qui s'explique par le fait que le Togo est un corridor de transhumance par excellence. Cette situation de dépendance d'un seul produit est d'autant plus inquiétante que l'itinéraire de ces troupeaux nomades peut être modifié d'un jour à l'autre, comme on l'a récemment constaté après la révision des taxes préfectorales sur le gros bétail. Selon Bauer B. et Snow W. (21), les produits prioritaires commercialisés sont les acaricides, les insecticides, les trypanocides (thérapeutiques et prophylactiques), les anthelmintiques et enfin les antibiotiques. Armé de ce dispositif
technique, le vétérinaire privé devra essayer de vendre non seulement les produits, mais aussi se faire payer un honoraire et se faire rembourser son déplacement. La réalité aujourd'hui est que la grande majorité des vétérinaires privés en Afrique de l'Ouest survivent grâce à la vente d'un type de produit en particulier : le trypanocide. Ceci se reflète dans les bilans d'exploitations où l'on constate que la proportion de trypanocides dans l'ensemble des ventes varie entre 35% (Cameroun, 18), 52% (Togo) et 70% – 90% (Burkina Faso, 21). Ceci est non seulement préoccupant d'un point de vue de la diversification de l'entreprise ou de l'apparition de la résistance aux trypanocides, cela pose aussi un problème de conflit d'intérêt. Quel est l'intérêt d'un vétérinaire privé à promouvoir par exemple une lutte intégrée contre la trypanosomose animale, incorporant les insecticides topiques, sachant que l'efficacité de cette lutte intégrée aura des répercussions sur les ventes de trypanocides, et qu'il peut perdre une partie importante de son revenu (22, 23, 24) ?

Du moins en ce moment, il ressort de l'étude que la viabilité structurelle et financière à moyen et long terme des cabinets vétérinaires privés au Togo semble bien réelle. Les deux cabinets privés dont les perspectives de survie sont inquiétantes se caractérisent par une faible présence auprès des propriétaires d'animaux (sensibilisation, soins cliniques, etc.). Le chiffre d'affaire dégagé par le cabinet n° 3 est probablement réalisé en grande partie à travers un réseau étendu d'agents vétérinaires et d'AVE qui couvrent toute la région et interceptent les troupeaux transhumants en route vers l'abattoir de Lomé. Il y a peu de doute qu'une grande partie du CA dégagé est réalisé sur des ventes de produits trypanocides aux nomades en provenance du Niger et du Burkina Faso. De ce fait, l'entreprise s'éloigne davantage de ce qu'on peut qualifier de "cabinet" et évolue vers une structure de grossiste régional, le premier de la sorte dans le milieu rural. Cette tendance se confirme par le fait que le vétérinaire privé en question venait (lors des enquêtes en fin 1998) de créer une deuxième entreprise ; entreprise du type SARL.

Un cabinet vétérinaire réalisait en 1998 un résultat net moyen d'environ 1,5 million FCFA (2.280 €). En prenant en compte le salaire mensuel incorporé au bilan de l'entreprise et déduit du revenu brut, un vétérinaire privé pourrait ainsi obtenir en moyenne un revenu mensuel (pour lui-même et ses employés) de près de 236.000 FCFA, environ 359 €. Le programme de privatisation du secteur vétérinaire au Kenya fait état d'un revenu mensuel moyen de 25.700 KSh (357 €) (19).

On peut conclure que l'occupation des zones potentiellement intéressantes est déjà avancée. Cependant, le point de saturation des cabinets vétérinaires privés en milieu rural est encore très éloigné. Des zones comme les préfectures du Klotu, du Haho, de Bassar ou d'Assoli, pour n'en évoquer que quelques-unes, ne sont pas encore desservies. On constate aujourd'hui que les activités d'élevage évoluent en fonction de la présence d'un service vétérinaire privé, alors qu'au début l'installation des vétérinaires privés était plutôt orientée vers les zones de forte présence de (gros) bétail. En termes d'analyse de rayon d'action 'viable' pour supporter un cabinet vétérinaire privé (rural), plusieurs tentatives ont été faites. Umali et al. (25) ont fait des calculs sur base des UBT nécessaires pour la survie d'un cabinet (survie en termes de break-
even point ou profit = 0) dans différents milieux d'élevage, avec et sans composante de pharmacie vétérinaire. En Guinée, les dépenses vétérinaires ne dépassent en moyenne pas les 50 FCFA/UBT/an, donc à peine 0,1 €. En RCA, elles seraient de l'ordre de 300 FCFA/UBT/an, soit 0,5 € environ (18). Une base extrêmement fragile pour se constituer une activité privée. Selon Thomé O. et al. (16), le nombre d'UBT par vétérinaire en Guinée est de 8400 UBT (en 1995), ce qui laisse supposer une certaine marge de croissance par rapport aux nombres avancés par Umali et al. (1992). Basé sur l'approche d'Umali, Flanagan (26) a repris les calculs pour la Zambie (Western Province) en appliquant un honoraire qu'il estime être plus réaliste pour les zones d'élevage traditionnel, c'est-à-dire 0,22 € et en prenant en compte les coûts d'achat de différents moyens de transport. Selon les différentes options de transport et de services cliniques par rapport aux ventes en pharmacie, le break even point se situe entre environ 15,000 et 80,000 UBT par vétérinaire privé. Outre ces chiffres impressionnants avancés en termes de bétail et donc de superficie à couvrir (au Kenya l'on a recensé des zones d'intervention de plus de 9,000 km²) (19), ce tableau démontre indirectement l'importance de deux facteurs : le mandat sanitaire qui peut contribuer à atteindre les chiffres avancés et l'importance de l'activité de pharmacie vétérinaire et donc du crédit.

Les cabinets vétérinaires privés ruraux au Togo sont créateurs d'emplois, en premier lieu et directement le vétérinaire privé lui-même, ensuite ses agents et indirectement le personnel des structures commerciales avec lesquelles ils collaborent (fournisseurs, fermes). Il est ressorti au cours des entretiens que les agents vétérinaires employés dans les cabinets sont en majorité d'anciens agents de la fonction publique ou des projets de l'Etat; ainsi, ces cabinets contribuent au redéploiement des ressources humaines que les services publics n'ont pu maintenir.

Thomé O. et al. (16) résument les stratégies de vétérinaires privés en Guinée, au Niger, au Burkina Faso et en RCA comme suit : obtenir l'exclusivité du transfert des fonctions vétérinaires du public vers le privé; sécuriser l'approvisionnement des intrants, soit en ayant une activité d'importation, soit en développant des liens avec plusieurs importateurs; constituer une clientèle captive en s'appuyant sur des réseaux de distribution existant sur le terrain (auxiliaires, agents de l'Etat); concentrer les activités sur la pharmacie vétérinaire en délégant les soins à leurs réseaux de distribution; s'impliquer via les structures professionnelles dans les prises de décisions politiques et, face aux incertitudes des politiques, au flou et aux imprécisions des textes, diversifier leurs activités vers d'autres secteurs : production, commerce d'aliments du bétail, bureau d'étude, ONG. Cette dernière stratégie est extrêmement importante et a été signalée dans notre étude au Togo, comme dans d'autres études (19). La diversification dans les secteurs des intrants agricoles, les fertilisants, les aliments pour bétail, les produits agrochimiques, le fil barbelé, le grillage de poulaille, le transport et le commerce de bétail, l'abattage et la transformation de la viande, la production de poussins d'un jour etc... est souvent essentielle pour la survie du cabinet. Ceci est donc (en ce moment) nullement un facteur négatif, au contraire il permet d'avoir des services vétérinaires privés dans des zones où un cabinet privé à 100% ne pourrait pas se développer. A
long terme, cet amalgame de fonctions peut donner lieu à des conflits d'intérêt.

L’appui fourni par plusieurs projets et programmes hier et aujourd’hui est reconnu comme primordial par les vétérinaires privés au Togo. Selon ces mêmes vétérinaires, cet appui a pris la forme d’un partenariat qui leur permet de mieux se faire connaître dans le milieu rural, d’une part, et de mieux pouvoir gérer leur cabinet, du point de vue aussi bien technique que commercial, d’autre part. Si au départ la prise en charge de frais de déplacements et le paiement de prestations de services représentaient une source de revenu appréciable et même essentielle, cela n’a pas entretenu une dépendance financière car aujourd’hui cet apport peut être considéré comme dérisoire.

Si l’on peut féliciter l’ensemble des cabinets vétérinaires d’avoir démarré leurs activités dans des conditions financières précaires, avec des ressources financières propres limitées et sans aucun appui institutionnel ni bancaire, il apparaît clairement après quelques années d’activité et au vu des CA réalisés et du potentiel disponible que l’accès au crédit s’avère indispensable pour une nouvelle dynamique (investissements en infrastructures et équipement).

En conclusion, une véritable privatisation ne pourra se faire qu’en prenant en compte les préoccupations des vétérinaires privés certes, mais aussi ceux des dirigeants des services publics (15), les vétérinaires des services publics, les techniciens d’élevage, les agents vétérinaires, les vaccinateurs et les auxiliaires villageois d’élevage. L’Etat ne peut de toute façon pas se permettre de ne pas se servir de toutes les compétences disponibles sur le marché, de l’auxiliaire qui connaît son milieu comme personne d’autre jusqu’au vétérinaire hautement qualifié et expérimenté.

Remerciements

Les auteurs saisissent l’occasion pour remercier tous ceux qui ont contribué au bon déroulement de cette étude et à l’élaboration du présent rapport. En premier lieu les vétérinaires privés qui à travers leurs disponibilité et leur confiance ont largement contribué à la pertinence des résultats obtenus. Cette étude a été réalisée grâce à l’appui financier et au conseil technique qu’apportent le Royaume de Belgique et la FAO au Projet Régional de Lutte contre la Trypanosomose Animale.

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EFFECTS OF EGG INCUBATION POSITION IN ELECTRIC TABLE-TYPE INCUBATOR ON HATCHABILITY AND POST-HATCH PERFORMANCE OF CHICKS

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EFFETS DE LA POSITION DE L'INCUBATION DE L'OEUF DANS UNE COUVEUSE ELECTRIQUE GENRE TABLE SUR L'ECLOSIVITE ET LA PERFORMANCE POST-ECLOSION DES POUSSINS

Résumé

Deux expériences ont été faites afin de déterminer les effets de la position de l'incubation de l'oeuf sur l'éclosivité et la performance post-éclosion des poussins jusqu'à l'âge de 6 semaines. Les résultats obtenus sur l'éclosivité étaient significatifs (P < 0,05). On a enregistré un taux d'éclosivité plus élevé (85,8%) dans la position horizontale ; en revanche, une valeur plus faible a été relevée dans la position verticale (64,2%). Chez les deux groupes, les poussins mâles étaient plus nombreux que les femelles, et les mâles pesaient plus lourd à l'éclosion que les femelles.

La mortalité à l'état embryonnaire était de 14,2% dans la position horizontale contre 35,9% dans la position verticale. Les poussins issus des œufs éclos dans la position horizontale avaient un gain pondéral plus élevé et une meilleure efficience alimentaire que ceux dans la position verticale. Le gain pondéral dans la position horizontale était de 5,8g/poussin/jour contre 5g/poussin/jour dans la position verticale. Une valeur de 4,8 pour le rapport aliments : gain a été observée dans la position horizontale, alors que l'on a enregistré une valeur de 5,9 dans la position verticale. La position d'incubation des œufs dans la couveuse électrique genre table est primordiale pour l'opération d'éclosion puisqu'elle a des effets sur l'éclosivité et la performance post-éclosion des poussins.

Summary

Two experiments were conducted to determine the effects of egg incubation position on hatchability and post-hatch performance of chicks to 6 weeks of age. Results obtained on hatchability were significant (P<0.05). Higher hatchability of 85.8% was recorded in the horizontal position while a lower value of 64.2% was obtained in the vertical position. In two treatment groups, male chicks out-numbered the females and the males were heavier in hatching weight than their female counterparts.

Late embryonic mortality was 14.2% in the horizontal position while that of vertical position was 35.9%. Chicks hatched in horizontal position were superior in body weight gain and efficiency of feed utilization than those hatched in the vertical position. Body weight gain in horizontal position was 5.8g/bird/day while that of vertical position was 5.0g/bird/day. A value of 4.8 for feed: gain ratio was observed in the horizontal position while a value of 5.9 was recorded in the vertical position. Incubation position of eggs in electric table-type incubator is critical to hatchery operation as it influenced hatchability.

Introduction

Traits affecting hatchability and post-hatch performance of chicks have been investigated in several studies. Such traits include quality of parent stock, hatching egg weight, positioning of eggs during incubation, and post-hatch holding time.

Previous studies on hatchability and post-hatch performance were based on chicks hatched from eggs set small ends up in automatic incubators. There is, however, limited information on hatchability and post-hatch performance of chicks hatched in table-type incubator where hatchable eggs can only be incubated in horizontal position on wire mesh.

This study was, therefore, designed to evaluate the hatchability and post-hatch performance of chicks hatched from different incubation positions in electric table-type incubator.

* Corresponding Author.
Materials and Methods

The experimental study was divided into two stages, i.e. (1) incubation of hatchable eggs and (2) management of chicks.

Experimental 1 - incubation of hatchable eggs

The JO-JO VICTORIA electric table-type incubator which has capacity for 50-60 eggs, was fumigated with formalin on Potassium Permanganate (ratio 2:1) for 30 minutes. The incubator was later switched on for 1 hour in order to attain the required temperature of 39.5°C. Forty-eight hatchable eggs of Lohmann breed, purchased from a commercial hatchery, were used for the study. The eggs were numbered and weighed individually. Twenty-four eggs were set horizontally on the left side of the incubator while the remaining twenty-four eggs were set vertically with broad ends up on a fabricated metal-tray on the right side of the incubator. The experiment was replicated thrice with eight eggs per replicate. Figure 1 shows the wire mesh, fabricated egg tray and positioning of eggs in the incubator.

Eggs were turned manually with sterile gloves 2 times daily (8.00 am and 6.00 pm) between the second and eighteenth day of incubation. The humidifier inside the incubator was topped with water at 48 hours interval. On the tenth day of incubation, eggs were tested for fertility by candling while final weight of the eggs was taken on the eighteenth day of incubation to determine weight loss. Chicks hatched were wing-tagged. Parameters monitored after incubation were hatchability, weight of

Figure 1: Diagramatic representation showing egg incubation position
chicks and mortality. Mortality was determined when the unhatched incubator eggs were opened up. Embryos that died in the early embryonic mortality was classified as dead-in-germ (DIG) while late embryonic mortality was classified as dead-in-shell (DIS).

Experiment 2 - Management of chicks

A total of 28 chicks, from those hatched in horizontal position and 14 from the vertical position were selected for the second stage of the study. The chicks were brooded separately for 7 days. At day old, they were vaccinated against Newcastle disease followed by vaccination against Gumboro disease on the 10th day. There were 2 treatments with 14 birds per treatment and 2 replicates where the birds were equalized for sex. Feed and water were provided ad-libitum for 6 weeks. Gross composition of experimental diet is presented in Table 1.

Parameters studied in the second stage included growth rate, feed intake, feed: gain ratio, efficiency of protein

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>% composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>46.00</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>18.00</td>
</tr>
<tr>
<td>Palm kernel cake</td>
<td>15.00</td>
</tr>
<tr>
<td>Wheat offal</td>
<td>12.00</td>
</tr>
<tr>
<td>Blood meal</td>
<td>4.65</td>
</tr>
<tr>
<td>Fish meal</td>
<td>0.20</td>
</tr>
<tr>
<td>Bone meal</td>
<td>2.50</td>
</tr>
<tr>
<td>Oyster shell</td>
<td>1.20</td>
</tr>
<tr>
<td>Premix</td>
<td>0.20</td>
</tr>
<tr>
<td>Salt</td>
<td>0.25</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

Calculated values

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude protein (%)</td>
<td>20.62</td>
</tr>
<tr>
<td>Crude fibre (%)</td>
<td>4.93</td>
</tr>
<tr>
<td>ME (Kcal/g)</td>
<td>2.76</td>
</tr>
<tr>
<td>Calcium (%)</td>
<td>1.10</td>
</tr>
<tr>
<td>Phosphorus (%)</td>
<td>0.60</td>
</tr>
</tbody>
</table>
utilization and mortality rate.

**Statistical Analysis**

Data obtained in both experiments were subjected to analysis of variance while means were separated using student’s t-test.

**Results**

Results obtained for egg weight loss were comparable with one another. A value

**Table 2: Effect of egg incubation position on hatching weight of chicks.**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Incubation positions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Horizontal</td>
</tr>
<tr>
<td>No. of eggs set</td>
<td>24</td>
</tr>
<tr>
<td>Average initial egg weight (g)</td>
<td>58.9±0.9</td>
</tr>
<tr>
<td>Average final egg weight (g)</td>
<td>55.1±0.8</td>
</tr>
<tr>
<td>Average egg weight loss (g)</td>
<td>6.5±0.1</td>
</tr>
<tr>
<td>Chick: egg weight ratio</td>
<td>0.7±0.1</td>
</tr>
<tr>
<td>Hatchability (%)</td>
<td>85.8±6.2&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

**Sex of chicks**

<table>
<thead>
<tr>
<th></th>
<th>Horizontal</th>
<th>Vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>11</td>
<td>8</td>
</tr>
<tr>
<td>Females</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Sex ratio</td>
<td>57.9±4.2</td>
<td>61.5±6.4</td>
</tr>
</tbody>
</table>

**Hatching Weight of chicks (g)**

<table>
<thead>
<tr>
<th></th>
<th>Horizontal</th>
<th>Vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>39.4±4.8</td>
<td>39.1±6.4</td>
</tr>
<tr>
<td>Female</td>
<td>35.7±5.9</td>
<td>36.0±8.9</td>
</tr>
<tr>
<td>Mean</td>
<td>37.6±4.2</td>
<td>37.6±4.6</td>
</tr>
</tbody>
</table>

**Mortality (%)**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dead-in-Germ (DIG)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Dead-in-Shell (DIS)</td>
<td>14.2±5.8&lt;sup&gt;b&lt;/sup&gt;</td>
<td>35.9±6.9&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a, b</sup> - means followed by different superscripts differed significantly (P<0.05)
of 6.5% egg weight loss was recorded in the horizontal position while 6.4% was obtained in the vertical position as shown in Table 2. This represents 10.9% and 10.8% of initial egg weight in the horizontal and vertical positions respectively.

Although early hatching of chicks occurred in the eggs set vertically, higher hatchability of 8.5% was recorded for eggs set horizontally while a lower hatchability value of 64.2% was obtained in the vertical position. Male chicks hatched in both incubation positions out-numbered the female counterparts. However, there were no significant differences in the hatching weight of male and female chicks in both incubation positions. The average hatching weight of male chicks in horizontal position was 39.4g (66.9% egg weight) while that of female chicks was 35.7g (60.6% egg weight). In the vertical position, average hatching weight of male chicks was 39.1 (65.5% egg weight) while that of female chicks was 36.0g (61.3% egg weight). The DIS in the horizontal position was 14.2% while that of vertical position was 35.9%.

Results of performance of chicks up to the age of 6 weeks are presented in Table 3. Although no significant differences were detected in both weight gain in both incubation positions, chicks hatched in horizontal position were superior in weight gain with a value of 5.8g/bird/day while those hatched vertically recorded a lower value of 5.0g/bird/day. However, chicks hatched vertically were superior in feed intake to

Table 3: Effect of egg incubation position on performance of chicks (0-6 weeks).

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Incubation positions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Horizontal</td>
</tr>
<tr>
<td>Final body weight (g/bird)</td>
<td>387.5±1.1</td>
</tr>
<tr>
<td>Body Weight gain(g/bird/day)</td>
<td>5.8±0.5</td>
</tr>
<tr>
<td>Feed intake (g/bird/day)</td>
<td>28.1±2.2</td>
</tr>
<tr>
<td>Feed: gain ratio</td>
<td>4.8±0.2</td>
</tr>
<tr>
<td>Protein intake (g/bird/day)</td>
<td>5.6±0.4</td>
</tr>
<tr>
<td>Protein Efficiency ratio</td>
<td>1.0±0.0</td>
</tr>
<tr>
<td>Mortality (%)</td>
<td>-</td>
</tr>
</tbody>
</table>

* b - means followed by different superscripts differed significantly (P<0.05).
those hatched horizontally. Results recorded for feed:gain ratio and efficiency of protein utilization in horizontal position were 4.8 and 1.0 respectively while values of 5.9 and 0.9 were obtained in the vertical position (Table 3).

**Discussion**

The range of 6.4 - 6.5% egg weight loss obtained in the present study is lower than the range of 10.9 - 12.8% egg weight loss reported in a similar study. However, Pebbles and Brakes obtained 12% egg weight loss in chicken eggs under conditions of artificial incubation while Ar and Rahn indicated that 15% (=5%) of the initial egg mass was the average value for water loss for most bird eggs. In the present study, hatchability was not directly influenced by egg weight loss since comparable results were obtained for egg weight loss in the two treatment groups.

The reason for early hatching of chicks noticed in the vertical position cannot be fully explained. Previous investigations, however, documented the implication of early hatching on chick weight. Early hatching chicks loose weight (10-12%) when held in the hatcher for prolonged periods. Early hatching of chicks in the vertical position, as observed in the present study, appeared not to have any advantage because a lower hatchability result was recorded for eggs set in the vertical position. The results obtained in a related study indicated that 89.3% hatchability was recorded for eggs set vertically with their large ends up.

Results obtained in this study on sex ratio conforms with the studies of Abiola where male chicks out-numbered their female counterparts following hatching and were heavier in weight. Chick weight at hatching in both treatment groups which ranged between 60.6 - 66.9% of egg weight, is in agreement with previous studies that chick weight at hatching is approximately 65% of egg weight. Research on hatching egg size and its significant effect on life cycle performance of leghorns has been documented. The higher mortality recorded in the vertical position in the later part of the incubation period which lowered per cent hatchability could be associated with effective manual turning of eggs set in the vertical position. In the present study, it was suspected that manual turning of the eggs set in horizontal position facilitated the transfer of more yolk nutrients to the embryos than those turned in vertical position since egg turning was easier on wire mesh than on fabricated egg tray.

Results obtained on body weight gain up to 6 weeks of age in both treatment groups appeared to have been influenced by the egg weight as a similar report on significant influence of egg weight on subsequent body weight gains has been documented. The superiority of chicks hatched in horizontal position in respect of weight gain could also be traced to better efficiency of feed utilization compared with those hatched in vertical position. In related study, no significant effects of incubation position were observed on broiler weights or feed: gain ratio at any age. Similarly, Lang et al and Gahel et al did not observe any significant benefit of rearing the the sexes separately.

**Conclusion**

The results of this study indicate that vertical positioning of eggs in a table-type incubator has no advantage over horizontal positioning. However, design of bigger electric table-type incubators with capacity for greater numbers of hatchable eggs is advocated because very small or big hatchable eggs are difficult to set in the egg of modern incubators.
Acknowledgement

The authors are grateful to the management of Alanco Agricultural Enterprises, Osiele, Abeokuta, Ogun State, Nigeria for providing storage facility in the hatchery for our departmental electric table-type incubator.

References


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The results of this study indicate that vertical positioning of eggs in the incubator has no advantage over horizontal positioning. However, batch of eggs treated in a table-type incubator with baying for greater numbers of hatchability might be required because the eggs are difficult to sort by the above method.

Conclusion

The results of this study indicate that vertical positioning of eggs in the incubator has no advantage over horizontal positioning. However, batch of eggs treated in a table-type incubator with baying for greater numbers of hatchability might be required because the eggs are difficult to sort by the above method.
EFFICACY OF ALPHAMETHRIN (DOMINEX®) POUR-ON IN THE CONTROL OF BOVINE TRYPANOSOMOSIS.

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Trypanosomosis is one of the most economically important diseases affecting livestock by causing reduced production through poor performance and death of the affected animals. In Kenya, the disease affects all domestic ruminants with the common trypanosome species being T. congolense and T. vivax. These trypanosomes are cyclically transmitted by tse-tse flies (Glossina spp.) which occupy a good proportion of the Coastal Kenya and some parts of the North-Eastern province.

The control of the disease has usually been aimed at the trypanosome by use of various curative and prophylactic drugs such as Berenil® and Samorin®. Such control measures have drawbacks in that there can be development of resistance by the trypanosomes and also the measures can be relatively expensive.

Other means of control are aimed at eliminating the tse-tse flies and are summarized as indirect (game destruction and vegetation removal) and direct (aerial application of insecticides to the fly habitat or by ground dissemination of aerosols and smokes). Further, fly traps baited with attractants such as pheromones and buffalo urine have been tried but without much success due such other reasons as theft of targets impregnated with insecticides as reported in Ethiopia.

All the above methods are useful but have their limitations in terms of demand on manpower, expense, formulation difficulties and indiscriminate destruction of economically valuable flora and fauna. Thus other practical and more easily applicable methods are desirable and involve mainly using various synthetic pyrethroids that are stable and can have useful spreading properties. Dominex® (Alphamethrin) is one such synthetic pyrethroid and was thus tested for it's effectiveness in protecting cattle against tse-tse flies in an endemic area.

The study was conducted at Kulalu region on a 250,000 acre ranch in the hinterland off the North Coast of Kenya, some 99 kilometers West of Malindi Town. The region borders Tsavo National Park with vegetation comprising acacia bushes and natural grass. The wild animals in the ranch include lions, zebras, elephants, water bucks, wart-hogs, monkeys, baboons, gazelles and jackals.

The ranch had 7,500 heads of cattle of mixed ages at the time of the study. From a herd of one-year-old heifers, 60 were selected randomly for inclusion in this trial and divided into two groups of 30 each. They were ear-tagged and one group (experimental) designated to receive Dominex® pour-on (FMC International) while the other remained as a control. Routinely, cattle were housed overnight in "bomas" (open sheds fenced with chain-linked wire) and were grazed during the day in pastures spread out around the "bomas". They were sprayed with acaricide every week but animals in the selected groups were exempted from this once the

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experiment began. Though the two groups were herded separately, they shared the same pastures but were housed in separate sheds.

The pour-on preparation (Dominex®) was applied at the rate of 15 mg/100 kg body weight as a 1.5% solution at the back line of the animal. Every two weeks, blood was bled from the ear vein of each animal early in the morning before 9.00 am. This blood was used to estimate the Packed Cell Volume (PVC,%) using the routine Hawksley's haematocrit technique. This same blood was used for trypanosome detection by the method of capillary tube examination at the buffy coat. Smears were then made of the positive cases to allow for trypanosome identification at the species level.

Whenever Trypanosoma species were detected, the positive animal was treated with 7 mg/kg body weight with dimenazene aceturate (Berenil®). All 60 animals were weighed at the beginning of the study and then monthly thereafter. At every sampling, cattle were examined for the presence of various ticks and their genera determined.

Four bi-conical traps, odour-baited with acetone/octenol and p-cresol, were set out in the pastures where cattle grazed and 24-hour tse-tse catches monitored every two weeks coinciding with the time of blood sampling. The initial fly trapping was done continuously for a week over an extensive area of the ranch to ascertain the presence of Glossina spp. Once the flies were trapped, they were identified by species following earlier descriptions and additional assistance from ILRI staff. Other dipteran flies trapped were also counted and identified to genus level.

Monthly rainfall was recorded (in mm) during the time of the study. A student t-test was used to determine the differences in PVC and tick numbers between the two groups of cattle.

The PVC means of the treatment group ranged from 27.1 - 30.6% and 26.3 - 30.4% among the controls, the differences were not significant. Two positive cases of trypanosome infection were diagnosed among the control group. The first was encountered two and a half months after the study began and the second during the third month. The first case was due to T. congolense and the second was a mixture of T. congolense and T. vivax. The positive animals were not necessarily characterized by anaemia as the respective P.C.V. values were 20% and 28%. Following treatment with Berenil® at 7 mg/kg body weight, both animals recovered.

During the first weighing, the average weight of the experimental and control group was 168 and 169.2 kg respectively. At the conclusion of the study, mean weight gain among the experimental group was 24.8 kg compared to a gain of 18.3 kg by the control group. This difference was however not statistically significant. During the last week of the study, 2.1 Glossina flies were caught per trap per 24 hours. Thereafter, the traps were confined to those grazing areas frequented by the two herds recruited in the study. The fly numbers recorded over 24 hrs per trap ranged from 0.25 to 0.75.

Majority of the flies caught comprised Glossina pallidipes (84.5%) and G. longipennis (14%). Other species caught were males of G. brevipalpis and G. austeni. Males of G. pallidipes made up 47.6% of the total catches while females were 36.9%. In the case of G. longipennis, males made up 6% while females were 8%. Rainfall was scanty on this ranch, such that, in September, no rains fell while in October, only 4.4 mm was recorded. However, November was a wet month with a total rainfall of 104.6 mm but December was relatively drier with only 5.9 mm recorded. Regarding the infestation rate with ticks, beginning one month after the beginning
of the study, control animals had consistently higher tick numbers than the experimental ones. Among the latter, the highest infestation rate recorded was 61% but in general, these rates were below 40%. The ticks identified from this group were mainly *Hyalomma* species. They were few in number, of small size and hardly engorged. However, with the control group, the following were always found in various stages of development and engorgement; *Hyalomma*, *Amblyomma* and *Boophilus* species. The lowest number (41.4%) of ticks were recorded a month after the study began, thereafter, a large proportion usually 100% harboured ticks. The difference in tick numbers between the two groups was found to be significant (P<0.005).

From the results of this study, it has been shown that, Dominex® pour-on does have a protective effect against tse-tse transmitted trypanosomases and ticks. Consequently, cattle herds exposed to tse-tse fly challenge are rendered less susceptible to the development of trypanosomiasis and had apparently improved body weight gains.

Infection rates with trypanosomes in the control group did not exceed 4%. Two major factors must have contributed to the low infection rates. Firstly, all cattle on this ranch had been prophylactically covered with Samorin® administration every three months. This must have considerably lowered the trypanosome pool from which infections could be acquired by tse-tse flies for transmission from animal to animal. Secondly, the tse-tse fly numbers were not high and this could be explained by the fact that Kalalu is usually dry and the study period more or less coincided with the greater part of the dry period as indeed, only in November were substantial rains recorded.

The two species of trypanosomes namely *T. congolense* and *T. vivax* encountered in this study concur with a report from the Witu region at the North Coast and from a nearby Galana ranch in cattle. These two species were reported as prevalent among goats at the South Coast of Kenya. These trypanosomes are cyclically transmitted by tsetse flies such as *G. pallidipes* and *G. longipennis*, both of which were encountered here. *G. pallidipes* was more abundant and hence may be more important than *G. longipennis* in the transmission of the disease to cattle. As regards the weight gains between the experimental and control groups, the former had a mean gain of 6.5 kg over the latter within a two and a half month period. This interpreted in monetary terms for 7,500 head of cattle over a period of one year means a loss of more than KES 12 m assuming a minimal value of KES 25.00 per kilogram live weight. Similar advantages in weight gain were reported among Orma Boran steers following the use of cypermethrin pour-on. This investigation which was conducted in a semi-arid region in the same province reported a financial rate of return of 122.6%.

In the work reported here, the pour-on was applied every two weeks and was able to control the various ticks prevalent. Conventionally, cattle in Kulaluru ranch were sprayed with acaricide every week and so the two-weekly application of Dominex® would save on the acaricide and related costs. The results of this work are also in agreement with among others a report from Zimbabwe where 1% flumethrin pour-on application at a 14-21 day interval was effective in controlling *Rhipicephalus* species. These results could then justify the use of Dominex® even in an area where the tse-tse challenge may not be relatively high as there are other attendant advantages.
Acknowledgements

This work was facilitated financially by FMC International while ADC management allowed the use of their animals, facilities and personnel. Many thanks are owed to the University of Nairobi through the Chairman, Department of Pathology, Microbiology and Parasitology for the valuable facilities that allowed the completion of this work.

References


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SHORT COMMUNICATION

INTESTINAL PARASITES AND BLOOD PICTURE OF DWARF FOREST GOATS SLAUGHTERED IN BUEA SUBDIVISION OF SOUTH-WEST CAMEROON.

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Faculty of Science, University of Buea, South West Province of Cameroon

Ruminants (cattle, sheep and goats) constitute a major source of animal protein in the diets of Cameroonians and provide a large proportion of meat that is consumed. Production of small ruminants in Cameroon is mainly in the hands of subsistence farmers who keep them not only for their meat but also for socio-economic reasons.

Results obtained from studies in Cameroon showed that all grazing pastures are infective throughout the year. This explains the high risk from parasitism to which animals are exposed irrespective of the husbandry method. Throughout the world, and especially in the tropics, internal parasites pose one of the major health limitations to grazing animals. Duval in his study on the control of internal parasites in ruminants reported that it is normal nature to find internal parasites in animals. The common internal parasites responsible for ruminant health problems include Coccidia, Babesia bigemina, Anaplasma marginale, Trypanosoma spp, Dictyocaulus filaria, Haemonchus contortus, Trichostrongylus spp, Fasciola gigantica, Moniezia expansa and Strongyloides papillosus.

In the field, invariably mixed infections are found, leading to a complex of signs and effects on health and productivity. Studies carried out by Assoku revealed that single helminth infections were less common in sheep and goats than mixed infections. Faecal cultures by Chandrawathani et al. indicated contortus to be the most common trichostrongylid of sheep and goats in a II farms studied, with prevalence rate of 85-90%.

Considering that helminthosis is major ruminant health problem, an in-depth knowledge of the parasite species infecting the animals is of utmost importance. The aim of this study was to identify the parasites that infect goats slaughtered in the Buea subdivision and their impact on the blood picture and health of these animals.

The investigation was carried out on 40 goats (11 in the 14-19 months age group, 19 in the 20-25 months age group, and 10 above 25 months of age) slaughtered in the Buea subdivision of South-West Cameroon. Samples were collected from animals at the slaughter house daily over a period of 6 months (January - June 2000). The goats were all of the Dwarf Forest breed and reared in this part of Cameroon where the vegetation is predominantly tropical rain forest.

Faecal samples were collected directly from the rectum of each animal in to labelled polythene bags and taken to the laboratory for examination and identification of strongyle and fluke eggs, lungworm larvae and Eimeria oocysts. Worm and coccidial burdens were evaluated by determining the number of eggs or oocysts per gram of faeces using a modified McMaster technique. Faecal samples from

* Corresponding Author.
the animals were cultured separately at ambient temperature for 7 days for identification of the genus of species by larval morphology

The goats were bled from the jugular vein into vacutainer tubes containing dried disodium ethylene diamine tetra-acetate (EDTA) as anticoagulant. Thin blood films stained with Giemsa were observed under the oil immersion objective (x100) for blood parasites and differential leucocyte count. Packed cell volume (PCV) and haemoglobin concentration (Hb conc.) were determined by the method laid down by (WHO) Red blood cell (RBC) and White blood cell (WBC) counts were determined by the method of Dacie and Lewis. Mean cell volume (MCV), mean cell haemoglobin (MCH) and mean cell haemoglobin concentration (MCHC) were calculated from values of PCV, Hb conc. and RBC using formulae stated by Dacie and Lewis

Differences in the haematological values between animals of the three age groups were investigated by analysis of variance while differences between male and female goats were assessed by the Student's t-test. Faecal egg, oocyst or larval counts between the different groups were compared by the Student's t-test or analysis of variance as appropriate, after log10 transformation data.

Mean parasitological values of slaughtered goats are shown in Table 1. The highest number of strongyle eggs per gram (epg) of faeces recovered in goats was 14,550. The difference in infection intensity as affected by age was statistically significant (P<0.05), with goats were generally more infected than females, the dif-

Table 1: Mean parasitological values of slaughtered Dwarf Forest goats in Cameroon (mean ± SE).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>No. examined</th>
<th>Mean egg count per gram of faeces (epg)</th>
<th>Mean larvae/g of faeces</th>
<th>Mean oocysts/g of faeces</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mixed infestation</td>
<td>H. contortus</td>
<td>Trichostrongylus</td>
</tr>
<tr>
<td>Age (months)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-19</td>
<td>11</td>
<td>895</td>
<td>570</td>
<td>101</td>
</tr>
<tr>
<td></td>
<td></td>
<td>±179</td>
<td>±178</td>
<td>±46</td>
</tr>
<tr>
<td>20-25</td>
<td>19</td>
<td>2032</td>
<td>842</td>
<td>218</td>
</tr>
<tr>
<td></td>
<td></td>
<td>±904</td>
<td>±542</td>
<td>±106</td>
</tr>
<tr>
<td>&gt;25</td>
<td>10</td>
<td>402</td>
<td>134</td>
<td>97</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td>F - test</td>
<td>P&lt;0.05</td>
<td>ns</td>
</tr>
<tr>
<td>Females</td>
<td>20</td>
<td>763</td>
<td>474</td>
<td>70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>±233</td>
<td>±205</td>
<td>±21</td>
</tr>
<tr>
<td>Males</td>
<td>20</td>
<td>2053</td>
<td>871</td>
<td>241</td>
</tr>
<tr>
<td></td>
<td></td>
<td>±845</td>
<td>±505</td>
<td>±101</td>
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<tr>
<td>Sex</td>
<td></td>
<td>M - test</td>
<td>ns</td>
<td>ns</td>
</tr>
<tr>
<td>All goats</td>
<td>40</td>
<td>1413</td>
<td>673</td>
<td>156</td>
</tr>
<tr>
<td></td>
<td></td>
<td>±443</td>
<td>±271</td>
<td>±53</td>
</tr>
<tr>
<td>Degree of infestation</td>
<td></td>
<td>Moderate</td>
<td>Light</td>
<td>Light</td>
</tr>
</tbody>
</table>

ns = significant
ference was not significant. The degree of infection with helminths was moderate for mixed infections and light when individual species were considered. Coccidian infection was heavy, with the goats in the 20-25 months age group being particularly affected.

The helminth parasites identified from larval cultures and differentiation are shown in Table 2, with the most prevalent during both the dry and wet seasons being H. contortus, Trichostrongylus spp and D. filaria. The prevalence of Fasciola gigantica was significantly higher (P<0.05), during the dry season while that of Strongyloides papillosus and Oesophagostomum columbianum high, but not significantly (P<0.05), during the wet season. Tapeworm infection (M. expansa) was recorded in only 5% of the goats. The prevalence of the coccidia of Eimeria spp was significantly higher (P<0.05) in wet season, with 76% of the goats infected as compared to only 27% in the dry season.

The young age at which the goats were slaughtered confirms the fact that these animals serve as an emergency cash reserve and a form of savings \(^\text{10,11}\).

Although the WBC counts were higher than those of clinically healthy goats, the mean values of PCV, Hb conc. and RBC were within the range of those reported for clinically normal Grassland Dwarf goats \(^\text{12}\). Apart from the higher proportion of basophils, monocytes and banded neutrophils observed, the differential leucocyte counts were within the range of those reported for clinically normal Nigerian goats \(^\text{13}\).

<table>
<thead>
<tr>
<th>Parasite</th>
<th>Season</th>
<th>Prevalence in goats (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>By Season</td>
</tr>
<tr>
<td>Strongyle infection</td>
<td>Dry</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>100</td>
</tr>
<tr>
<td>Haemonchus contortus</td>
<td>Dry</td>
<td>90.9</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>93.1</td>
</tr>
<tr>
<td>Trichostrongylus spp</td>
<td>Dry</td>
<td>90.9</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>89.7</td>
</tr>
<tr>
<td>Strongyloides papillosus</td>
<td>Dry</td>
<td>54.6</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>79.3</td>
</tr>
<tr>
<td>Oesophagostomum columbianum</td>
<td>Dry</td>
<td>18.2</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>34.5</td>
</tr>
<tr>
<td>Dictyocaulus filaria</td>
<td>Dry</td>
<td>90.9</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>72.4</td>
</tr>
<tr>
<td>Fasciola sp</td>
<td>Dry</td>
<td>63.6</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>20.7</td>
</tr>
<tr>
<td>Eimeria spp.</td>
<td>Dry</td>
<td>27.3</td>
</tr>
<tr>
<td></td>
<td>Wet</td>
<td>75.9</td>
</tr>
</tbody>
</table>

The higher mean WBC count (17,400= 1,500 per mm\(^3\)) recorded in our study can be attributed to high level of subclinical parasitic infections. The decrease in the mean cell volume and the mean haemoglobin of red cells with increasing age.

The anaemia observed may have been due to the ability of haematophagous species, especially H. contortus, to induce re
duction in PVC, erythrocyte and haemoglobin levels by the blood letting activities of the fourth stage larvae (L4) and adult worms\textsuperscript{14,15}. An average of 0.5 ml of blood is lost per day in moderate infections, especially with \textit{H. contortus}, in males than females was accompanied by lower values of PCV, MCV and MCH. The lowered PCV in male goats signals the exhaustion of the host's ability to replace lost RBC and is, in large measure, due to an acute shortage of iron, although RBC values are known to decrease with advance in age\textsuperscript{15}.

The degree of infestation as depicted by the egg of larval or oocyst count per gram of faeces was generally low. Roberts and Swan\textsuperscript{16} showed that a highly significant relationship existed between the faecal egg counts and the total number of adult worms. The moderate degree of infestation, as revealed by the mean strongyle egg counts per gram of faeces, was most probably an indication of infestation that effects health and production in these animals\textsuperscript{17}.

The highest mean strongyle egg count per gram of faeces was observed in the 20-25 months age group, with the peak at the beginning of the rainy season. This corroborated with past observations\textsuperscript{1,18,19} and provided evidence that rainfall is a major determinant of the availability and transmission of the strongylid nematodes of small ruminants. The rise in egg counts observed in the early rainy season was probably from residual adult worms. A peak of helminth infestation demonstrated by the peak egg excretions during the rains is a major factor contributing to the reduction in PCV\textsuperscript{11}.

Mixed infections as opposed to single infections severely affect the haematological parameters\textsuperscript{20}. The absence of single infections in the goats slaughtered indicates the high prevalence and diversity of parasite species infecting goats in Cameroon.

A prevalence rate of 92.5\% for \textit{H. contortus} was reported in this study and was similar to the findings in Nigeria goats (89-100\%)\textsuperscript{21}. The prevalence of fascioliasis in goats (32.5\%) as detected by faecal examination was higher than the results obtained in Nigeria\textsuperscript{22}. The higher prevalence of fascioliasis in the dry season than in the rainy season may have been attributed to scarcity of good pastures so that goats tend to graze more than they browse. Furthermore, goats frequent the potentially dangerous marshy areas around the streams during the dry season where they easily pick up the metacercariae.

The animals in our study within the age range of 15-25 months were heavily infected with \textit{Eimeria spp.} These parasites are known to be fairly common in weaner and non-immune animals\textsuperscript{2,3,23}.

**Acknowledgements**

The authors express their appreciation to Miss. J.M. Mbwaye and Mr. Eboule of the Veterinary Clinics in Buea and Muea respectively, and to the butchers for their cooperation throughout the field work.

**References**


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SHORT COMMUNICATION

COMPARATIVE EVALUATION OF CRUDE PREPARATION OF AZADIRACHTA INDICA LEAF AND ALBENDAZOLE® IN NATURALLY INFECTED GOATS WITH INTERNAL PARASITES.

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The importance, global economic impact, and concern with internal parasites of small ruminants in sub-Saharan Africa have been well indicated¹². The major internal parasites of goats around Adami-Tulu, Ethiopia belong to the genera Haemonchus, Oesophagostomum and Trichuris³. This study's aim was to evaluate and compare Azadirachta indica leaf with Albendazole efficacies on helminths of goats at Adami-Tulu Research Centre (ATRC), located 165 km south of Addis Ababa. Altitude of ATRC is 1650 m above sea level and the climate is semi-arid with an annual rainfall of 750 mm.

Azadirachta indica (neem tree) is one of the popular medicinal plants throughout the world. The leafy part of the plant was collected from Zeway town, Ethiopia and allowed to dry under shade at a room temperature. The dried leaf was then pounded to a powder in a locally made wooden mortar and kept in a plastic container for a week or so until use. A total of 55 goats were divided into 7 treatment groups of 7-8 goats receiving different doses of the crude preparation of Azadirachta indica leaf: 0 (negative control), 0.5, 1, 2, 5 and 10 g/kg body weight (BWT) and 7.5 mg Albendazole (positive control) per kg BWT per os. These constituted treatments 1,2,3,4,5,6 and 7 respectively. Animals were kept in pens separately according to their sex and treatment groups. They fed natural hay ad lib and supplemented with about 100g/head/day wheat bran in-group feeding, and had access to water once in a day. Eggs per gram of faeces (EPG) were determined using the MacMaster technique⁴ and expressed as EPG of faeces with a lower detection limit of 50 EPG. Packed cell volume (PCV) was determined by the Microhaematocrit method⁵. EPG was carried out on days 0, 1, 3, 7, 14 and 21 while PVC and BWT were determined on 0, 7, 14, and 21 days. Total adult parasite counts were done by randomly selecting and slaughtering two respective goats from each of the treatment groups. For this, the gastro-intestinal tract (abomasum, small and large intestines) was removed, separated, opened, and thoroughly washed with tap water. The contents of each part of the gastro-intestinal tract were then added to a large open sieve of 500μm and 250μm sieve with the larger one being placed on top of the smaller and visually inspected for adult parasites and counting done.

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Faecal egg count reduction (FECR) test was done by calculating the mean percent in FECR using the formula:

\[
\frac{(N-n)}{N} \times 100:
\]

where \( N \) = Mean worm egg counts before treatment
\( n \) = Mean worm egg counts after treatment

The FECR percentage was calculated for all days of sampling to assess the antihelmintic effect of the plant. The General Linear Model (GLM) procedure was used to generate the least squares means of changes in BWT and PCV. Total worm counts were transformed by natural logarithm of 10 (worm count + 1) to calculate geometric means for beach treatment groups. Each neem leaf and Albendazole treated groups were compared with the control group using a t-test for means with equal variances.

The results indicated that the effect of the herb was observed on the first day after treatment and reduced EPG counts in the range of 6.09-16.99% while Albendazole produced significant reduction (94.82%, \( p < 0.001 \)) on the same day (Table 1). Except for Albendazole treated goats whose PCV increased by 3% (\( p < 0.01 \), in all treatment groups PCV values decreased on the 21st day after treatment. Reduction in EPG counts was observed in groups that received neem leaf according to increasing dosage level: maximum for goats on high dose, minimal and/or zero for those on low dose. The highly significant reduction in EPG count in Albendazole treated goats was confirmed by total clearance of adult worms except for very low number of Trichuris (Table 2). The least squares means (± standard errors) of effect of the different treatments on BWT, PCV, EPG and log-transformed EPG (LOGEPG) is presented in Table 3. Changes in PCV values were significantly different (\( p < 0.001 \)) between treatment groups. In general, PCV decreased in all treatment groups except in Albendazole treated group in which PCV values increased by 3%. The change in BWT did not show significant difference between treatments (\( p < 0.05 \)). However, all treatment groups showed increase in BWT from the smallest of 0.19 kg (treatment group 4) to the highest of 1.93 kg (treatment group 6). This was followed by Albendazole treated group 7.

The leaf part of the neem plant has been used to control gastro-intestinal parasites of chicken and cattle. In vitro test of the leaf extract of neem was also reported to have cercaricial effects. The small percentage (FECR = 6.09-16.99%) anthelmintic efficacy of neem tree leaf could be due to the use of crude preparations, which might have low amounts of the chemical responsible for removal of parasites. The FECR observed in this study is low when compared to 35.7-52.7% and 35.3-40.0% reported earlier from the use of the neem tree seed extract in goats and sheep, respectively in Indonesia. However, other reports in Ethiopia indicated that the neem seed extract showed no reduction in EPG count in goats. These differences in percentage FECR could be due to the use of different parts of the plant, doses, methods of preparation and/or animal species used. According to the National Research Council (NRC), the chemical responsible for parasite removal in the neem tree is azadirachtin. However, the azadirachtin content in neem could vary considerably due to edaphic, climatic, or genotypic differences that might affect its availability, uptake and synthesis.

The temporary reduction in EPG count in this study suggests that the mechanism responsible for reduction in EPG count might be due to an egg production depression effect of the plant on the parasites. This is supported by observation of large
Table 1: Mean percent reduction in EPG count of goats treated with crude preparations of the neem tree leaf and Albendazole

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Days pre- and post-treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Per kg BWT</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Treatments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>0g</td>
</tr>
<tr>
<td></td>
<td>% FECR</td>
</tr>
<tr>
<td>2</td>
<td>0.5g</td>
</tr>
<tr>
<td></td>
<td>% FECR</td>
</tr>
<tr>
<td>3</td>
<td>1g</td>
</tr>
<tr>
<td></td>
<td>% FECR</td>
</tr>
<tr>
<td>4</td>
<td>2g</td>
</tr>
<tr>
<td></td>
<td>% FECR</td>
</tr>
<tr>
<td>5</td>
<td>5g</td>
</tr>
<tr>
<td></td>
<td>% FECR</td>
</tr>
<tr>
<td>6</td>
<td>10g</td>
</tr>
<tr>
<td></td>
<td>% FECR</td>
</tr>
<tr>
<td>7</td>
<td>Alb 7.5 mg</td>
</tr>
<tr>
<td></td>
<td>% FECR</td>
</tr>
</tbody>
</table>

Day 0, day before treatment; **(P<0.01); *** (P<0.001); FECR, faecal egg count reduction test; Alb, Albendazole.

Table 2: Geometric means (standard deviation) of helminth worm counts (and % prevalence) in slaughtered experimental goats

<table>
<thead>
<tr>
<th>Parasitic genus</th>
<th>Treatments</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Haemonchus</td>
<td>25.4±1.5*</td>
<td>7.8±1.4*</td>
</tr>
<tr>
<td>Trichuris</td>
<td>11.0±1.1*</td>
<td>3.7±2.0*</td>
</tr>
<tr>
<td>Oesophagostomum</td>
<td>1.0±1.0*</td>
<td>2.2±3.1*</td>
</tr>
<tr>
<td>Moniezia</td>
<td>1.0±1.0*</td>
<td>1.0±1.0*</td>
</tr>
<tr>
<td>Dicrocium</td>
<td>1.0±1.0*</td>
<td>4.0±7.4*</td>
</tr>
<tr>
<td>Fasciola</td>
<td>1.0±1.0*</td>
<td>2.8±4.4*</td>
</tr>
<tr>
<td>Total</td>
<td>36.3</td>
<td>21.6</td>
</tr>
</tbody>
</table>

Row means with different superscripts differ significantly (P<0.05); nd; no data
Table 3: Least square means (± standard errors) of effects of the neem tree leaf on eggs per gram of faeces (EPG), log transformed EPG (LOGEPG), packed cell volume (PCV) and body weight.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>EPG</th>
<th>LOGEPG</th>
<th>PCV (%)</th>
<th>Body Weight Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Initial</td>
<td>Final</td>
</tr>
<tr>
<td>1</td>
<td>1138.03±191.61</td>
<td>2.80±0.07</td>
<td>31.87±1.60</td>
<td>25.86±1.73</td>
</tr>
<tr>
<td>2</td>
<td>743.61±184.41</td>
<td>2.69±0.07</td>
<td>25.25±1.50</td>
<td>24.82±1.90</td>
</tr>
<tr>
<td>3</td>
<td>1505.39±172.27</td>
<td>2.80±0.07</td>
<td>25.25±1.50</td>
<td>23.58±1.60</td>
</tr>
<tr>
<td>4</td>
<td>840.36±178.83</td>
<td>2.80±0.07</td>
<td>24.15±1.50</td>
<td>21.73±1.60</td>
</tr>
<tr>
<td>5</td>
<td>1016.35±174.43</td>
<td>2.80±0.07</td>
<td>25.75±1.50</td>
<td>23.01±1.60</td>
</tr>
<tr>
<td>6</td>
<td>2333.79±230.17</td>
<td>2.80±0.07</td>
<td>26.77±1.50</td>
<td>24.65±1.50</td>
</tr>
<tr>
<td>7</td>
<td>3177.71±183.79</td>
<td>2.80±0.07</td>
<td>24.73±1.60</td>
<td>27.73±1.60</td>
</tr>
</tbody>
</table>

**P<0.01; ***P<0.001; ns; not significant (P>0.05)

numbers of adult parasites during post-mortem examinations. This warrants the need for further investigation on the use of different extracts of the plant under controlled experimental conditions. Despite the increase in EPG count and decrease in PVC, the increase in weight of high dose receiving goats of treatment 6 might be due to the appetizing nature of neem, which was not confirmed in this study, for data on feed intake was not collected. The reduction in EPG count in control groups starting from the 7th day onwards might be due to the inherent nature (chance) of parasites and/or due to the low number of adult parasites counted at necropsy, mainly *Haemonchus* (6.72% (25.4/378.2), Table 2), a parasite known for its high fecundity. In addition, this low adult parasite count and reduction in EPG count was supported by absence of significant difference (p<0.05) in PCV of values between Albendazole treated and negative control groups (Table 3). Albendazole at 7.5 mg/kg BWT not only significantly (p<0.001) reduced EPG count and increased PCV but also cleared adult parasites except *Trichuris*.

It is concluded that crude preparation of the leaf of neem tree should not be used, as an anthelmintic in goats in such an environment as Adami-Tulu to replace commercial anthelmintics such as Albendazole, and that Albendazole is not effective on *Trichuris* at 7.5 mg/kg BWT. However, further research is required on the use of the active ingredient of the neem tree leaf on internal parasites.

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References


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SHORT COMMUNICATION

BOOPHILUS MICROPLUS (ACARI: IXODIDAE) REPORTED FOR THE FIRST TIME IN KENYA.

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The presence of the tick, *Boophilus microplus*, is being reported for the first time in Kwale district (04° 13’ S, 39° 25’ E). This finding was made from collections of ticks from wild and domestic hosts at Kwale district, Coast Province of Kenya. The ticks were collected during a training course on "Tick Management" sponsored by the International Centre of Insect Physiology and Ecology (ICIPE) in September 1998. The only recorded *Boophilus* tick species in Kenya has been *B. decoloratus* and since 1974, no systematic study has been conducted on tick distribution in the country.

During the course held in September 1998, ticks were collected from different pre-direction sites of a variety of game animals (elephant, zebra, giraffe, buffalo, waterbuck, impala, cheetah and lion) which were darted with immobilon at Tsavo National Park (02° 59’ S, 38° 28’ E). Ticks were also collected from different pre-direction sites of domestic animals (cattle, goats and sheep) in Kilifi (03° 40’ S, 39° 55’ E) and Kwale districts. The ticks were preserved in 70% alcohol and latter identified using dissecting microscope2,3.

*B. microplus* ticks were identified from tick collections made from domestic animals in Kwale district and were morphologically district from *B. decoloratus* collected from the same district. *B. microplus* had 4/4 hypostome dentitions (D) (Plate 1a) compared to *B. decoloratus* which had 3/3 dentitions (D) (Plate 2a). The adanal plate (AD) of *B. microplus* had an angled margin with a small spur (S) that does not approach the posterior margin (M) of the body (Plate 1b). *B. decoloratus* has an elongated adanal plate (AD) with two spurs (S) posteriorly. The external spur is small while the internal spur (IS) is elongate and reaches beyond the external margin (M) of the body (Plate 2b).

*B. microplus* could have existed at the Kenya coast for sometime but has not been identified due to inadequate identification skills. There is also a possibility that the tick could have spread from the northern coastal region of Tanzania where it is known to exist4. The higher levels of *B. microplus* infestation observed on host animals suggest that the tick could be out-competing or displacing *B. decoloratus*.

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Plate 1a: Antero-ventral side of male *B. microplus* hypostome showing dentition of (D)

Plate 1b: Postero-ventral side of male *B. microplus* showing adanal plate (AD), spur (S) and posterior margin (M) of the body.
Plate 2a: Antero-ventral side of male *B. decoloratus* showing hypostome dentition of 3/3 (D)

Plate 2b: Postero-ventral side of male *B. decoloratus* showing adanal plate (AD), internal (IS) and external spur (S) and posterior margin (M) of the body.
*microplus* was not found among ticks collected from wildlife in Tsavo National Park. *B. microplus* is the vector for *Babesia bovis* which is more pathogenic than *Babesia bigemina* transmitted by *B. decoloratus*. It is therefore important to conduct a survey to assess the extent of the tick and prevalence of *B. bovis* in Kenya especially along the southern Kenya and northern Tanzania boundaries.

**References**


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SHORT COMMUNICATION

PREVALENCE OF ANTIBODIES TO INFECTIOUS BURSAL DISEASE VIRUS (IBDV) IN VILLAGE CHICKENS IN SAHEL ZONE OF NIGERIA

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Poultry production in Nigeria comprises of backyard or free range system and intensive rearing on commercial scale. Free range system of production plays an important role as nearly every family keeps some birds within the homestead. Commercial holdings of exotic breeds of poultry in large scale are found in the southeastern and western parts of Nigeria, while free range system of production is mostly practised in the Northern regions, with local (village) chickens as the most preferred birds.

Birds on free range live by scavenging crop residues and paddy fields. As a result of this, they are exposed to diseases such as infectious bursal disease (IBD). Outbreaks of the disease characterized by high mortality and morbidity have been reported in Nigeria. The disease is of great economic importance through mortality and prolonged immuno-depression of the infected chickens at early age. Infectious bursal disease viral antibody prevalence rates in village chickens in which clinical disease is rarely reported and routine vaccination is rarely undertaken has been reported in Nigeria.

This paper reports the prevalence of antibodies to IBDV in village chickens in the Sahel zone of Nigeria. The work was carried out in Maiduguri, Borno State. A total of 1790 chickens were screened for antibodies against IBDV using gel precipitin test (AGPT). Blood samples were collected from village chickens at slaughter on weekly basis between the months of January and December 1999. The samples were collected from various poultry slaughter slabs around Maiduguri Monday Market. The chickens were raised on free range and brought to the market for sale from different parts of the state and from the neighbouring states in the region.

For the analysis, blood was collected in vacutainer tubes and kept at room temperature to clot. The blood was then centrifuged at 1500rpm for 10 minutes to separate the serum. The sera were stored in bijou bottles at -20°C until tested. The antigen was prepared from a pool of bursa harvested from birds with typical lesions which was ground and suspended in 5ml of phosphate buffered saline, pH 7.2 containing 800 I.U. of penicillin and 2mg of streptomycin. The tissue was centrifuged and the supernatant used as antigen after confirmation by comparing with standcard antisera supplied to the National Veterinary Research Institute, Vom, Nigeria, by the Central Veterinary Laboratory, Weybridge, Surrey, UK.

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Agar gel precipitin test (AGPT) was used to test the samples. The serum samples were placed into surrounding wells and the IBD virus antigen into the central well. The petri dishes were incubated at 37°C in a humid chamber and observed daily for lines of precipitation. Samples showing lines of precipitation were considered positive. The monthly prevalence rate of IBD precipitating antibodies was then calculated.

Of the 1,790 samples tested, 1,085 (60.6%) were positive for IBDV precipitating antibodies. Although the monthly prevalence rates varied from one month to another, however, the variations were not significantly different (P>0.05). There was a fluctuation between February (61.8%) and June (31.3%). As from July (38.3%), the prevalence rate rose steadily through November (72.3%) and began to drop again in December (61.1%) (Table 1). The month of November had the highest prevalence rate (72.3%) and June had the lowest (31.3%) (Table 1).

The result of this work showed that IBD is still endemic in the region as evidenced by antibody prevalence rates in the village chickens in this study. Although prevalence rates did not vary significantly (P>0.05) between the short wet season (July to September) and the long dry season (November to January) (Table 1). The findings from this work are in agreement with the results obtained by other workers. Stress and intercurrent infections are important factors in eliciting clinical disease.

The source of IBD in village chickens is certain. Chickens on free range roam alongside other birds (ducks and turkeys) in search of food and shelter. These birds

<table>
<thead>
<tr>
<th>Month</th>
<th>Number of samples tested</th>
<th>Number of positive samples</th>
<th>Prevalence rate (%)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>169</td>
<td>116</td>
<td>68.6</td>
</tr>
<tr>
<td>February</td>
<td>140</td>
<td>108</td>
<td>61.8</td>
</tr>
<tr>
<td>March</td>
<td>157</td>
<td>80</td>
<td>51.0</td>
</tr>
<tr>
<td>April</td>
<td>163</td>
<td>104</td>
<td>63.8</td>
</tr>
<tr>
<td>May</td>
<td>119</td>
<td>73</td>
<td>61.3</td>
</tr>
<tr>
<td>June</td>
<td>131</td>
<td>41</td>
<td>31.3</td>
</tr>
<tr>
<td>July</td>
<td>120</td>
<td>46</td>
<td>38.3</td>
</tr>
<tr>
<td>August</td>
<td>200</td>
<td>110</td>
<td>55.0</td>
</tr>
<tr>
<td>September</td>
<td>160</td>
<td>97</td>
<td>60.6</td>
</tr>
<tr>
<td>October</td>
<td>139</td>
<td>115</td>
<td>69.6</td>
</tr>
<tr>
<td>November</td>
<td>148</td>
<td>107</td>
<td>72.3</td>
</tr>
<tr>
<td>December</td>
<td>144</td>
<td>88</td>
<td>61.1</td>
</tr>
</tbody>
</table>

* Not significantly different (P>0.05).
could serve as potential source of infection to village chickens. Poultry droppings used on farms as manure could also serve as a source of infection.

Vaccination of village chickens against diseases such as IBD is rarely undertaken, therefore, the antibodies detected are probably due to active infection. It is therefore recommended that IBDV antibodies prevalence in other domestic birds (ducks and turkeys) be investigated as well as control and preventive measures such as regular vaccination of young chicks and parent stocks be instituted. Also proper husbandry practices such as good housing, stocking density, good brooding should be encouraged as stress is major predisposing factor of the disease.

References


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Présentation des articles
Deux exemplaires des articles doivent être adressés à Monsieur le Rédacteur en Chef, Bulletin de la Santé et de la Production animales en Afrique, Organisation de l'Unité Africaine/Bureau interafricain des Ressources animales, P.O. Box 30786, Nairobi, Kenya.


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

Genres d'articles publiés dans le Bulletin
- des communications originales,
- des brèves communications,
- analyse des articles proposés par le Rédacteur,
- des éditoriaux,
- le courrier des lecteurs,
- analyse d'ouvrages,
- informations et annonces.

Format des articles
Les manuscrits doivent respecter les conditions suivantes : le titre doit être concis et ne pas dépasser plus de 15 mots, il est suivi du (des) nom(s) de l'auteur (ou des auteurs) et des établissements où le travail a été effectué, ainsi que de l'adresse pour les correspondances si elle n'est pas la même.

Le résumé ne doit pas dépasser 200 mots. Son texte bref et concis comprendra les principaux résultats et la (les) conclusion(s) de l'étude.

L'introduction expose le but de la recherche.

Le matériel et les méthodes utilisés.

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Remerciements éventuels.

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Le nom de l'auteur (ou des auteurs) suivi des initiales du ou des prénoms, l'année de parution (entre parenthèses), l'abréviation du titre du périodique suivant la "World List of Scientific Periodicals" (soulignée), le numéro de la première page. Le titre de l'article ne doit pas être inclus.

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Le nom du pays, l'année faisant l'objet du rapport, puis le nom du service ou de l'organisation, le numéro de la première page.

Si le même auteur est cité plus d'une fois, ses publications seront indiquées dans l'ordre chronologique dans la liste bibliographique et s'il y a plus d'une publication, les lettres "a,b,c," seront ajoutées aussi bien dans la liste bibliographique que dans le texte.

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

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