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Cowdriosis in Senegal : some epidemiological aspects

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Les résultats d'une étude sur l'abondance d'*Amblyomma variegatum* dans des zones écologiques différentes et des taux d'infection par *Cowdria ruminantium* dans les nymphes et les adultes de la tique de la zone nord-guinéenne sont présentés. En même temps la séroprévalence a été déterminée. Selon cette étude, le vecteur est le plus fréquent dans la zone nord-guinéenne, suivie par la zone sud-soudanienne et la zone côtière des Niayes. Ailleurs, les populations de la tique sont absentes ou peu importantes. Le taux d'infection dans la zone nord-guinéenne est élevé : 1,1 p. 100 au moins chez les tiques adultes et 7,8 p. 100 chez les nymphes. La séroprévalence dans les zones nord-soudanienne et soudano-sahélienne est très basse à l'intérieur, tandis qu'elle est plus élevée proche de la côte.

Mots-clés : Cowdriose - *Cowdria ruminantium* - Tique - *Amblyomma variegatum* - Épidémiologie - Sérum - Prévalence - Antigène - Immunofluorescence indirecte - Sénégal.

INTRODUCTION

Since the 1970s, the introduction of exotic dairy cattle of high productivity in the Niayes ecological zone has emphasized the importance of cowdriosis as the major pathological constraint to the development of animal production (3). Further findings on the mortality of native goats occurring periodically confirm also the role of this disease (4).

The lack of reliable information on the epidemiology together with the control of this infection as a major objective, justify the ongoing research programme aiming to investigate the most important parameters of the disease : the vector, namely *Amblyomma variegatum* (Fabricius, 1794), the agent and the immune status of the livestock.

The vector distribution has been established by previous studies consisting in collecting ticks on cattle of different ecological zones and on wildlife (7). Studies have been performed in the Niayes area to assess the importance of the infection by *Cowdria ruminantium* (12). As far as the

immune status is concerned, data are available for only few ecological zones (13).

This article records the abundance of the vector in the main geographical areas and the tick infection rate in the North Guinean zones; the seroprevalence in the Sudano-Sahelian, North Sudan and the hinterland of the North Guinean zones is also reported.

MATERIAL AND METHODS

Abundance of the vector

The distribution and the abundance of *Amblyomma variegatum* have been established essentially by studies on the population dynamics of this species in different ecological zones of Senegal, *i.e.* :

- Sahelian zone : annual rainfall of 300 to 500 mm, grassland type of vegetation ;
- Coastal region of the Niayes: annual rainfall of 400 to 600 mm , grassland and palm trees (*Elaeis guineensis*) in clay soil depressions ;
- Sudano-Sahelian zone : annual rainfall of 500 to 800 mm ; shrubby grassland ;
- North Sudan zone : annual rainfall of 800 to 1 000 mm ; grassland and woodland ;
- South Sudan zone : annual rainfall of 1 000 to 1 200 mm ; woodland ;
- North Guinean zone : annual rainfall of 1200 to 1850 mm ; woodland and forest.

In each of these zones, apart from the coastal Niayes, 40 cattle, 40 sheep and 40 goats were subjected to a monthly removal of all their body ticks. In the particular case of the Niayes region, the study was limited to cattle and goats since sheep do not graze on natural pastures. To compare the abundance of *A. variegatum* in the different ecological zones, the level of cattle infestation by adult ticks is used as the criterion. In fact, the larvae and nymphs of this species may engorge on several types of hosts, particularly birds.

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Infection rate of *Amblyomma variegatum* in the North Guinean zone

During the rainy season of 1992, unfed adult ticks were collected from cattle grazing in day time on natural pastures. Unfed nymphs were collected according to the same procedure.

The adult ticks and nymphs were fed on rabbits for 4 to 5 days. They were divided into groups of 3 ticks and ground, then suspended in PBS (pH 7.2). The suspension was centrifuged for 5 min at 500 rpm. The supernatant was injected into a sheep by the intravenous route. A total of 30 sheep was used for each tick stage (nymphs and adults). The temperature of the sheep was recorded daily.

All sheep originated from cowdriosis-free areas in Northern Senegal. If we assume that one infected tick can transmit the infection to an inoculated sheep, the following formula can be applied :

$$IRo^* = \frac{\text{Number of tiks infected}^{**}}{\text{Total number of ground ticks infected}} \times 100$$

An infected sheep (showing hyperthermia) may die or survive. In the latter case, it is challenged with blood infected with *Cowdria ruminantium* originating from the same area. If no reaction is observed, it is considered that the previous hyperthermia was caused by tick infection.

Seroepidemiology

In March 1992, blood was collected from animals living in the following ecological zones :

- 451 cattle in the North Sudan zone ;
- 271 cattle in the hinterland of the North Guinean zone (Kedougou) ;
- 149 cattle in the hinterland of the Sudano-Sahelian zone ;
- 354 cattle in the coastal area of the latter zone.

The sera collected were centrifuged at 3 000 rpm for 15 mn. The supernatant was dispensed in 2 ml tubes and stored at -20°C.

Antigen production

A Senegalese strain of *Cowdria ruminantium* originating from the Niayes area has been maintained in endothelial cells (1, 15). A suspension of elementary bodies and morulae is stored at -20°C in 200 µl aliquots.

* : IRo = Infection rate observed

** : Number of sheep infected

Indirect immunofluorescence

The test was carried out as described by MARTINEZ *et al.* (15).

The antigen suspension is thawed and diluted 1/100 in PBS (pH 7.4), and a drop of 10 µl is deposited on each spot of special slides for immunofluorescence. The slide is dried and then fixed in methanol. 10 µl of serum (1/80 dilution) is deposited per spot. A positive and negative control serum at the dilution of 1/80 is applied to one spot each of each slide. The slide is incubated for 30 min in a moist chamber at room temperature. The slide is washed for 10 min in PBS and an antbovine IgG conjugate diluted 1/100 in PBS with 0.01 % Evans blue is applied. Slides are again kept in a humid atmosphere for 30 min and washed in PBS, as previously.

They are mounted with glycerol and examined under a fluorescent microscope.

RESULTS

Abundance

The data on tick collection are reported in table I. The parasite burden caused by adult ticks during one year (map 1) allows to define three levels of abundance determined as follows :

Range of data

$$9,618 - 53 = 9,565.$$

If we retain 3 classes corresponding to the 3 categories : not abundant, abundant and very abundant, the length of the class is :

$$9,565 : 3 = 3,188.$$

Therefore the superior limit of the first class is : $3,188 + 53 = 3,241$

not abundant : $< 3,241$

The second class interval is : $[3,241-6,429]$: abundant.

The third class interval is : very abundant : $> 6,429$.

For the different ecological zones we get the following classification :

- not abundant : North Sudan and Sudano-Sahelian zones ;

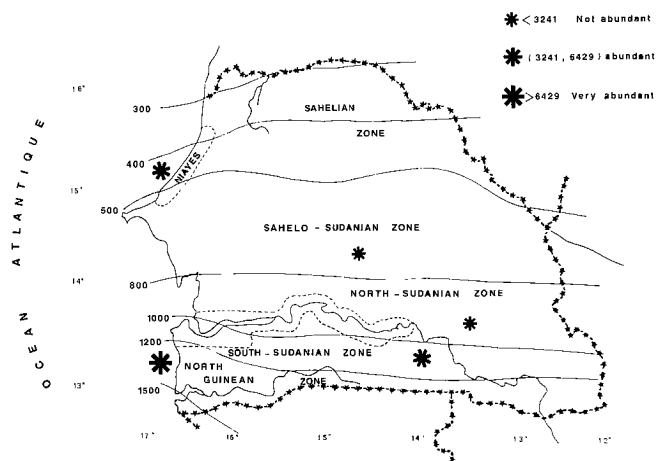
- abundant : Niayes and South Sudan zones ;

- very abundant : North Guinean zone.

TABLE I Ticks collected on cattle, sheep and goats.

	Ecological zones					
	Niayes*	Sahelian	Sudano-Sahelian	North Sudan	South Sudan	North Guinean
Cattle (n = 40)	L = 365 N = 1 457 A = 6 834	0	A = 53	A = 89	L = 1 020 N = 3 179 A = 3 294	L = 8 060 N = 3 739 A = 9 618
Sheep (n = 40)		0	A = 2	L = 2	L = 1 131 N = 421 A = 53	L = 837 N = 735 A = 163
Goats (n = 40)	L = 43 834 N = 5 675 A = 525	0	0	L = 1 N = 4	L = 307 N = 141	

L = Larvae
N = Nymph
A = Adult tick
* Study done during 18 months



Map 1 : Abundance of Amblyomma variegatum.

Infection rates

Nymphs

Seven out of 30 inoculated sheeps contracted the infection, 2 died, 5 recovered and did not react to a new inoculation of infected blood. The observed infection rate is the following :

$IRo = 7/90 \times 100 = 7.8 \%$

Adult ticks

One out of 30 inoculated sheep died; no other sheep showed hyperthermia. The infection rate is :

$IRo = 1/90 \times 100 = 1.1 \%$

Seroprevalence

The results are given in table II. The seropositivity is low in the Sudano-Sahelian and North Sudan zones. However, the prevalence is higher near the coastal area of the Sudano-Sahelian zone.

TABLE II IFA test results of cattle of different ecological zones.

Ecological zones	Number of sera	Number of positives	% positives
Sudano-Sahelian			
- Hinterland	149	8	5.3
- Coastal	354	107	30.2
North Sudan	451	31	6.9
North Guinean			
- Hinterland	271	92	33.9

DISCUSSION

The distribution and the abundance of *A. variegatum* in the different ecological zones correspond to the observations made by MOREL (16) on the normal habitat of the species in West Africa. However this tick is not the most important numerically, in comparison with the other species connected with livestock in the South Sudan and coastal Niayes zones (5, 9). In the latter regions, *Boophilus geigy* AESCHLIMANN and MOREL, 1965 and *B. decoloratus* (KOCH, 1844) are numerically more important. On the contrary, the species is definitely dominant in the North Guinean zone (10).

The observed infection rates are based on a low number of ticks and sheep and their statistical significance remains to be assessed.

The high infection rate of ticks in the North Guinean zone recalls the data recorded in the coastal Niayes. The infection rates of adult ticks are equivalent in these two areas. On the other hand, nymphs are more infected in the Niayes. However the high infection rate of ticks in the coastal North Guinean zone and the abundance of the vector may explain the very high prevalence of infection found previously among cattle in this area. Concerning the seroprevalence, the low positivity rates in the hinterland of the Sudano-Sahelian zone and the North Sudan zone correspond with the scarcity of the vector. The coastal microclimate allows a larger population of this tick. This fact explains the high prevalence in this site.

The seropositivity of the Niayes and coastal North Guinean zones which reaches about 90 % is far higher (13).

The serological cross reaction between *Cowdria ruminantium* and *Ehrlichia bovis* (2, 14) does not allow an easy interpretation of the results obtained.

Notwithstanding the low prevalence of the infection in the Sudano-Sahelian and North Sudan belt, no mortality is recorded so far in cattle, even if the disease is recognized in goats of this area.

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REFERENCES

1. BEZUIDENHOUT (J.D.), PATERSON (C.L.), BARNARD (B.J.H.) *In vitro* cultivation of *Cowdria ruminantium*. *Onderstepoort J. vet. Res.*, 1985, **52** : 113-120.
2. CAMUS (E.). Contribution à l'étude épidémiologique de la cowdriose (*Cowdria ruminantium*) en Guadeloupe. Thèse Doc Sci., Orsay, Université de Paris Sud, 1987. 202 p.
3. GUEYE (A.), MBENGUE (Mb.), KEBE (B.), DIOUF (A.). Note épizootiologique sur la cowdriose bovine dans les Niayes au Sénégal. *Revue Élev. Méd. vét. Pays trop.*, 1982, **35** : 217-219.
4. GUEYE (A.), MBENGUE (Mb.), DIOUF (A.). Situation épizootiologique actuelle de la cowdriose des petits ruminants dans les Niayes du Sénégal. *Revue Élev. Méd. vét. Pays trop.*, 1984, **37** : 268-271.
5. GUEYE (A.), MBENGUE (Mb.), DIOUF (A.), SEYE (M.). Tiques et hémoparasitoses du bétail au Sénégal. I. La région des Niayes. *Revue Élev. Méd. vét. Pays trop.*, 1986, **39** : 381-393.
6. GUEYE (A.), CAMICAS (J.-L.), DIOUF (A.), MBENGUE (Mb.). Tiques et hémoparasitoses du bétail au Sénégal. II. La région sahélienne. *Revue Élev. Méd. vét. Pays trop.*, 1987, **40** : 119-125.
7. GUEYE (A.), CAMICAS (J.-L.). Distribution des tiques du bétail. In : Élevage et potentialités pastorales sahéliennes. Synthèses cartographiques, Sénégal. Maisons-Alfort, France, IEMVT, CTA, 1989. p. 20.
8. GUEYE (A.), MBENGUE (Mb.), DIOUF (A.). Tiques et hémoparasitoses du bétail au Sénégal. III. La zone nord-soudanienne. *Revue Élev. Méd. vét. Pays trop.*, 1989, **42** : 411-420.
9. GUEYE (A.), MBENGUE (M.), DIOUF (A.). Tiques et hémoparasitoses du bétail au Sénégal. IV. La zone sud-soudanienne. *Revue Élev. Méd. vét. Pays trop.*, 1989, **42** : 517-528.
10. GUEYE (A.), MBENGUE (Mb.), DIOUF (A.), SONKO (M. L.). Tiques et hémoparasites du bétail au Sénégal. V. La zone nord-guinéenne. *Revue Élev. Méd. vét. Pays trop.* (à paraître).
11. GUEYE (A.), MBENGUE (Mb.), DIOUF (A.). Tiques et hémoparasites du bétail au Sénégal. VI. La zone soudano-sahélienne. *Revue Élev. Méd. vét. Pays trop.* (à paraître).
12. GUEYE (A.), MBENGUE (Mb.), DIOUF (A.). Epidémiologie de la cowdriose au Sénégal. I. Étude de la transmission et du taux d'infection d'*Amblyomma variegatum* (Fabricius, 1794) dans la région des Niayes. *Revue Élev. Méd. vét. Pays trop.* (à paraître).
13. GUEYE (A.), MARTINEZ (D.), MBENGUE (Mb.), DIEYE (Th.), DIOUF (A.). Epidémiologie de la cowdriose au Sénégal. II. Résultats de suivis séro-épidémiologiques. *Revue Élev. Méd. vét. Pays trop.* (à paraître).
14. LOGAN (L.), HOLLAND (C.J.), MEBUS (C.A.), RISTIC (M.). Serological relationship between *Cowdria ruminantium* and certain *Ehrlichia*. *Vet. Rec.*, 1986, **119** : 458-459.
15. MARTINEZ (D.), SWINKELS (J.), CAMUS (E.), JONGEJAN (F.). Comparison of three antigens for the serodiagnosis of heartwater by indirect fluorescent test. *Revue Élev. Méd. vét. Pays trop.*, 1990, **43** : 159-166.
16. MOREL (P.C.). Contribution à la connaissance de la distribution des tiques (Acariens, Ixodidae et Amblyommidae) en Afrique éthiopienne continentale. Thèse Doct. Sci. nat., Fac. Sci. Orsay, Univ. Paris, 1969. 388 p. (Annexe cartographique, 62 cartes).

GUEYE (A.), MBENGUE (Mb.), DIEYE (Th.), DIOUF (A.), SEYE (M.), SEYE (M.H.). Cowdriosis in Senegal : some epidemiological aspects. *Revue Élev. Méd. vét. Pays trop.*, 1993, **46** (1-2) : 217-221

The results of a study on the abundance of *Amblyomma variegatum* in different ecological zones and of *Cowdria ruminantium* infection rates in nymphal and adult ticks of the North Guinean zones are given. Joint research is also conducted on the evaluation of seroprevalence. In this study, it appears that the vector is most important in the North Guinean zone, followed by the South Sudan and the coastal Niayes zones. Elsewhere, the tick populations are not significant or absent. The infection rate in the North Guinean zone is high : 1.1 % at least for adult ticks and 7.8 % for nymphs. The seroprevalence in the North Sudan and the Sudano-Sahelian zones is very low in the hinterland whereas the values are higher near the coast.

Key words : Heartwater - *Cowdria ruminantium* - Tick - *Amblyomma variegatum* - Epidemiology - Sera - Prevalence - Antigen - Indirect immunofluorescence - Senegal.

GUEYE (A.), MBENGUE (Mb.), DIEYE (Th.), DIOUF (A.), SEYE (M.), SEYE (M.H.). Aspectos epidemiológicos de la cowdriosis en Senegal. *Revue Élev. Méd. vét. Pays trop.*, 1993, **46** (1-2) : 217-221

Se describen los resultados de un estudio sobre la abundancia de *Amblyomma variegatum* en diferentes zonas ecológicas, así como las tasas de infección de *Cowdria ruminantium*, tanto en garrapatas adultas y como en estadio ninfal, en diferentes zonas al norte de Guinea. Conjuntamente se llevó a cabo una evaluación de la seroprevalencia. Según nuestros resultados, el vector es más importante en la zona norte de Guinea, el sur de Sudán y las zonas costeras de Niayes. En el resto del territorio las poblaciones de garrapatas son mínimas o nulas. La tasa de infección, en la zona norte de Guinea es elevada : al menos 1.1 p. 100 para las garrapatas adultas y 7.8 p. 100 para las ninfas. La seroprevalencia es baja en las regiones internas del norte de Sudán y en las zonas sudano-sahelinas, mientras que en las zonas costeras es más elevada.

Palabras claves : Cowdriosis - *Cowdria ruminantium* - Garrapata - *Amblyomma variegatum* - Epidemiología - Suero - Prevalencia - Antígeno - Inmunofluorescencia indirecta - Senegal.