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Paralytic Cattle Syndrome: causes and treatments in Mali

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Abstract

A study was conducted between 1999 and 2005 to understand cattle paralytic syndrome causes, which are of great concerns for breeders in the Sahelian and sub humid areas of Mali and to find ways of combating it. Survey was carried out in the regions of Kayes, Koulikoro, Sikasso, Timbuktu and Gao, where 29 samples of fodder and 415 of blood were taken. The plasma was extracted by centrifugation at 3000 rpm for 10 minutes. Dry matter, crude protein, organic matter, cellulose, phosphorus, calcium, potassium, magnesium, sodium, zinc, copper, manganese and iron were determinate in the fodder, and total protein, albumin, total globulin, Alpha, Beta and Gamma globulin, globulin / albumin ratio, calcium, phosphorus, magnesium, zinc and copper in the plasma samples. Then, a treatment trial was conducted in three areas with veterinary drugs: calcimag, hipracal-FM, and cofacalcium at doses of 5 ml / 10 kg bodyweight at one day apart and 1 ml / kg bodyweight three days apart. Fodder had low levels of crude protein (4.5 ± 0.62%), calcium (0.3 ± 0.03%), phosphorus (0.1 ± 0.01%) and magnesium (0.3 ± 0.02%). Biochemical parameters were statistically the same in all animals regardless of the clinical state with the exception of calcium, which was lower (2.25 mmol / l) in patients versus 2.67 mmol/l in the healthy ($p = 0.028$). Animals treated with the licking stone were 100% healed, while with injectable drugs, the healing rate varied between 73% and 86%, compared to 1% in the control group. The cost of treatment varied between 5.72 and 2.42 US dollars depending on drug and doses. These results are being used by extension services in the study areas.

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Keywords: Causes, chemical composition, plasma biochemical profile, cure rate.

Résumé

Une étude a été conduite entre 1999 et 2005 pour comprendre les causes du syndrome paralytique des bovins qui constitue une préoccupation des éleveurs des zones sahélienne et subhumide du Mali et d'en trouver les moyens de lutte. Une enquête a été effectuée dans les régions de Kayes, Koulikoro, Sikasso, Tombouctou et de Gao, au cours de laquelle 29 échantillons de fourrages et 415 de sang ont été pris. Ensuite, le plasma a été extrait par centrifugation à 3000 tours/minute pendant 10 minutes. La matière sèche, les protéines brutes, la matière organique, la cellulose, le phosphore, le calcium, le potassium, le magnésium, le sodium, le zinc, le cuivre, le manganèse et le fer ont été déterminés dans les échantillons de fourrages, tandis que la protéine totale, l'albumine, la globuline totale, Alpha, Béta et Gamma globuline, le rapport globuline/albumine, le calcium, le phosphore, le magnésium, le zinc et le cuivre ont analysés dans le plasma. Ensuite, un essai de traitement a été conduit dans trois localités avec des produits vétérinaires : calcimag, hipracal-FM, et cofacalcium aux doses de 5 ml/10 kg de poids vif à un jour d'intervalle et 1 ml/kg de poids vif à trois jours d'intervalle. Les fourrages avaient des teneurs faibles en protéines brutes (4,5 ± 0,62%), en calcium (0,3 ± 0,03%), en phosphore (0,1 ± 0,01 %) et en magnésium (0,3 ± 0,02%). Les paramètres biochimiques étaient statistiquement les mêmes chez tous les animaux quel que soit l'état clinique à l'exception du calcium, qui était plus bas (2,25 mmol/l) chez les malades contre 2,67 mmol/l chez les sains ($p = 0,028$). Les animaux traités avec la pierre à lécher ont été guéris à 100%, tandis qu'avec les produits injectables, le taux de guérison a varié entre 73 % et 86%, contre 1% dans le lot témoin. Le coût du traitement a varié entre 5,72 et 2,42 dollars Etats-Unis en fonction dal quantité des produits et des doses. Ces résultats sont en cours d'utilisation par les services de vulgarisation dans les zones d'étude.

Mots clés : Causes, composition chimique, profil biochimique plasmatique, taux guérison

Introduction

Since some thirty years, breeders in the Sahelian zone of Mali have been confronted with a disease called "differently" according to ethnic groups: "Dissidimi bana" in Bambara, "Bougueinshi" in Moor, "Moubraïka" in Tamacheck (Traoré, 1985; Kouyaté, 1988), Gountè in sonhrai in the Tonka area, Bardi in Moor in the Tinhara and Gossi area, Tadacart dacard which means staggering disease in Tamacheck in the Anderamboukane area (Ouologuem *et al.,* 2006b). Once seasonal and isolated, this disease has now become endemic in many localities. The geographic area of the disease covers a South-North zone from the beginning of the Sahel to Mauritania and an East-West zone from Tilemsi to the Senegalese border (Kouyaté, 1988). However, several cases have been encountered in southern Mali where rainfall is between 900 and 1,200 mm / year (Ouologuem *et al.,* 2006a).

In each herd, the rate of disease affected animals varies between 3 and 5% (Ouologuem *et al.,* 2006a). Cattle aged 3 years and older and in good condition are the main target of the disease. The main features of the syndrome are: pica, including osteophagia, motor incoordination, decubitus, rapid death or slow healing (Traoré, 1985; Kouyaté 1988; Ouologuem *et al.,* 1998 and 1999).

Clinical signs recall the pathology which had raged in the 1965s in the Ferlo in Senegal called "Gniédio" in fulani and described by many researchers (Calvet *et al.,* 1965; Calvet,1971; Calvet *et al.,* 1976; Friot *et al.,* 1971; Friot *et al.,* 1973; Conrad *et al.,* 1985). In researching this pathology cause, Calvet *et al.,* (1965) isolated *Clostridium botulinus* serotypes C and D from dead animals tissues with all the clinical signs. They have not only been able to reproduce the disease by administering parts of organs from suspect animals to healthy ones, but also to limit the mortality of healthy animals by vaccination with the vaccine prepared from the two serotypes. According to these authors, if mineral deficiency, in particular phosphorus is the cause of osteophagy, the high mortality of animals and which is often of an abrupt nature, is due to botulinum toxins. Conrad *et al.,* (1985) reported that in several Latin American countries the appearance of botulism is linked to the existence of phosphorus deficiency and osteophagy.

However in Mali, treatments with veterinary products (antibiotics, anthelmintics, vaccinations in particular against botulism) have not given satisfactory results (Kouyaté, 1988), although a deficiency in phosphorus, copper and selenium has been observed in serum analyzes by Kouyaté *et al.,* (1995). On the other hand, all botulinum toxin analyzes results were negative (Ouologuem *et al.,* 2001) as the attempts to contaminate healthy animals from sick animal organs did not cause the disease. The objective of this study was to deepen the knowledge in the nutritional aspect as probable cause of the patient and to propose a treatment.

Materials and methods

Test 1: Diagnosis of pathology causes

Surveys were carried out in Kayes, Koulikoro, Sikasso, Timbuktu and Gao regions. During this survey, 29 samples of pasture fodder and 415 blood samples were taken. Three groups of animals were identified during the collection time: those apparently healthy, those showing syndrome signs and those having suffered from the pathology in the past according to the breeders.

Animals blood samples were taken early in the morning before going for grazing. Plasma was obtained immediately after collection by centrifugation at 3000 rpm for 10 minutes. Then, samples were kept cold at 4 ° C in the field and kept at - 20 ° C in the laboratory before sending them for analysis to the Inter-State School of Veterinary Sciences and Medicine biochemistry laboratory (EISMV) of Dakar (Senegal) for the following determinations: total proteins, albumin, α, β, γ globulin, Ca, P, Mg, Zn, Cu. The plasma proteins were analyzed by spectrophotometry after the Biuret reaction at 545 nm. Then, protein fractions were analyzed by electrophoresis and read using a densitometer. Minerals were measured spectrophotometrically at different wavelengths depending on the elements.

In some localities, supine patients were sacrificed and autopsies were performed, during which special attention was paid to the cartilages joints state of the forelimbs and hindquarters state.

Laboratory data were analyzed through descriptive statistics (frequency, arithmetic mean, coefficient of variation) and variance by considering the clinical condition of the animals as a factor. The means were compared by the orthogonal contrast method.

Test 2. Patient treatments

A treatment experiment on patients was conducted in Sikasso (southern Mali), in Timbuktu and Gao (northern Mali), regions. As sick animals and their clinical statuses were identified, they were divided into four batches.

Batch 1 (check): basic ration (unlimited bush straw + 1 kg of Huicoma cattle feed - ABH). ABH contained 0.46 UF of net energy and 139 g of digestible nitrogenous matter (MAD) per kilogram of dry matter, while bush straw contained 0.40 UF and zero grams of MAD.

Batch 2: injection of 5 ml /10 kg bodyweight of Cofacalcium or hipracal-FM, or CalciMag (veterinary solutions containing calcium, phosphorus and magnesium) one day apart + basic ration (unlimited straw + 1 kg ABH);

Batch 3: injection of 1 ml / kg bodyweight of Cofacalcium or hipracal-FM or CalciMag three days apart + basic ration (unlimited straw + 1 kg of ABH);

Botch 4: animal lick stone (photo 1) + basic ration (unlimited straw + 1 kg of ABH)

Batches 2 and 3 were each subdivided into three subgroups where each received an injectable product. Batch 1, 2 and 3 consisted decubitus animals or very difficult to move, while those of batch 4 moved more easily. Products used were administered by intravenous injection. The dose used in batch 1 was that indicated on the instructions for use, while that in batch 2 was proposed by the research team. Treatment continued until the animals showed no signs of the disease or died despite treatment. Animals have not undergone any other treatment such as antiparasitics, anti-inflammatories, antibiotics or others.

Ethical & research approval

During the implementation of this theme, there was no Ethics Committee at the "Comité National de la Recherche Agronomique-CNRA level in Mali. But, the theme on "Paralytic Cattle Syndrome: Causes and Treatments in Mali" has been included in the Malian Institut d'Economie Rurale-IER research program since 1995. The research protocol was accepted during the 2nd session of the IER Committee Program. On the basis of results obtained between 1995 and 2002, the Regional Commissions of Research Result Users (CRU) of Sikasso and Gao regions requested treatment experimentations in their respective regions through call N ° 006 / 04 / RD / CRRVA-GAO of the National Committee for Agricultural Research-NCAR.

The treatment protocols of the Institute d'Economie Rural of 2004 were validated by the CRRVA and NCAR. From an ethical standpoint, all cattle owners have been informed of all handlings their animal should undergo. After these awareness activities, cattle owners freely joined the program. It was cattle owners who phoned the research staff for the presence of sick animals in their herds and monitored treatment progress. All reports were presented to the CRA, CRRVA and CNRA. After validation, feedback sessions were organized to share results in both regions. This is why cattle treatments are applied nationwide

Results

Test 1: Diagnosis of the pathology causes ±

Chemical composition of range fodder

Fodder on the pastures used by cattle herds was very poor in protein, calcium, phosphorus and magnesium, while microelements contents in particular of iron and manganese were very high (Table 1).

Table 1: organic and mineral content of fodder sampled in pasture areas in 2002 in the region of Kayes (content/100)

Variables	N	Mean	Minimum	Maximum
Total nitrogen matter	29	4.50±0.62	1.06	13.06
Ash	29	5.60±0.48	2.35	12.80
Cellulose	29	40.14±1.30	22.79	49.00
Sodium	29	0.35±0.09	0.05	1.67
Phosphorus	29	0.10±0.01	trace	0.25
Calcium	29	0.30±0.03	trace	0.86
Potassium	29	1.40±0.09	0.33	2.29
Magnesium	29	0.23±0.02	0.1	0.49
Zinc, mg/kg	29	19.83±1.77	2.6	48.70
Copper, mg/kg	29	11.45±1.19	trace	20.83
Manganese, mg/kg	29	197.50±43.50	48.8	1027.60
Iron, mg/kg	29	258.80±57.60	10.1	1055.50

Biochemical parameters of the serum based on animal clinical states

Calcium was the only element that was different between healthy and healed animals on the one hand and sick ones on the other hand (Table 2). All other parameters were statistically the same between the three clinical states of the animals.

Table 2: proteins, albumin, globulin fractions and minerals contents according to the clinical state of surveyed animals in Kayes region, 2002.

Serum parameters	«Healthy» (n= 393)	« healed» (n = 9)	« sicks » (n = 14)	Mean±SE (n = 415)	*P*
Protein, g/l	71.1	81.6	74.2	71.3±0.69	0.247
Albumin, g/l	32.2	40.4	33.7	32.9±0.43	0.206
Globulin, g/l	35.9	37.5	36.4	35.9±0.51	0.959
αglobulin, g/l	8.2	10.4	10	8.2±0.12	0.169
βglobulin, g/l	6.2	8.8	6.6	6.3±0.16	0.28
γ globulin, g/l	22.1	18	21.8	22.1±0.35	0.506
Albumin/Globulin	0.93	1.07	0.95	0.93±0.01	0.541
Mg, mmol/l	1.77a	1.20a	1.07a	1.74±0.36	0.937
Ca, mmol/l	**2.67^{a}**	**2.59^{ab}**	**2.25^{b}**	**2.66**±0.03	**0.028**
P, mmol/l	1.65	1.38	1.68	1.65±0.03	0.646
Zn, µmol/l	2.82	2.8	3.37	2.84±0.05	0.232
Cu, µmol/l	2.69	2.18	2.49	2.68±0.06	0.619

On the bold line, numbers followed by the same letter are not statistically different at the 5% threshold.

Findings after sacrificed animals' autopsies

Foreign bodies were found in all sacrificed animals rumen, while internal organs were apparently normal. However, cartilage erosion has been observed in the scapular - humeral, humero - radio-ulnar or femuro-tubio-patellar joints of all animals. This erosion was superficial on some joints (Photo 1), but on others, it was deep, causing a bone sore, especially in animals in decubitus (Photo 2).

Photo 1: Superficial erosion of the humero-radio-ulnar joint cartilage of cattle in the région of Kayes in 2002

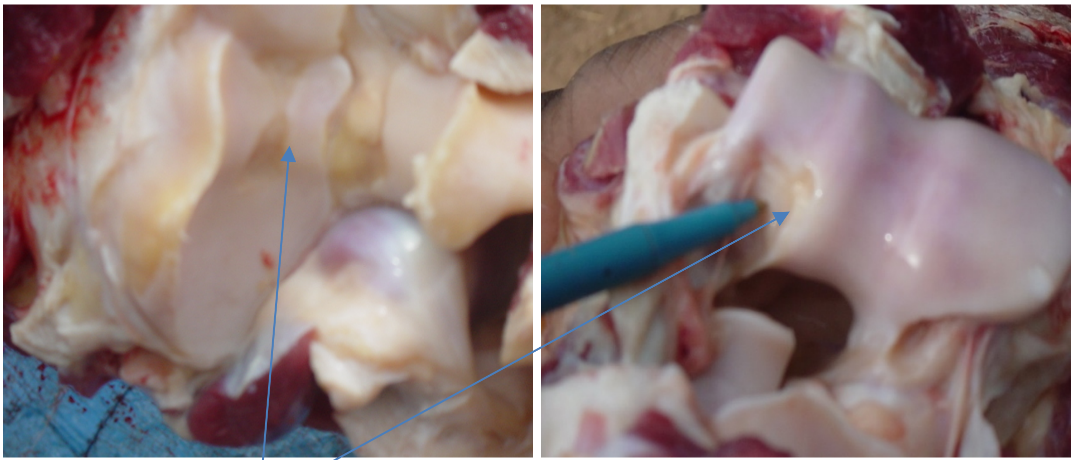


Photo 2: Deep erosion of the forelimb joints cartilage of cattle in the region of Kayes in 2002.

Test 2. Treatment test for sick animals

Patients and control results animal treatments with various products are presented in Table 3. Four days after treatment onset, an improvement was noted in batches 2, 3 and 4, while in control batch, mortalities were recorded. After eight days of treatment, disease external signs disappearance was noted in certain patients in batches 2, 3 and 4 who started a normal walk and were eating properly, while mortality continued in the control batch. The first cases of mortality were observed in batches 2 and 3. On the other hand, in batch 4, no mortality was recorded. The relatively high mortality rate in batches 2 and 3 is largely explained by the shepherds leaving sick animals in the pastures or in the herds departure camps for transhumant.

Table 3: Balance of treatments in different batches based on number of days and clinical conditions of animals in 2005 - 2007

Number of days of treatment	Clinical conditions	Batch 1		Batch 2		Batch 3		Batc 4	
		N	%	N	%	N	%	N	%
	Decubitus	10	45.5	23	36.5	14	24.1	0	0
0	Difficulty of movement	12	54.5	40	63.5	44	75.9	6	100
	Total	**22**	**100.0**	**63**	**100**	**58**	**100**	**6**	**100**
	Worsening	8	36.4	3	4.7	3	5.2	0	0
	Improvement	0		42	66.7	43	74.1	6	100
	Dead	4	18.2	0	0	0	0	0	0
4	No improvement	10	45.5	18	28.6	12	20.7	0	0
	Total	**22**	**100.0**	**63**	**100**	**58**	**100**	**6**	**100**
	Slaughtered *	2	9.1	1	1.6	1	1.7	0	0
	Worsening	9	40.9	1	1.6	0	0	0	0
	Improvement	0	0.0	26	41.3	27	46.6	4	66.7
8	Healed	0	0.0	20	31.7	24	41.4	2	33.3
	Dead	2	9.1	12	19	5	8.6	0	0

	No improvement	9	40.9	3	4.8	1	1.7	0	0
	Total	**22**	**100.0**	**63**	**100**	**5**	**100**	**0**	**100**
12	Slaughtered	4	18.2	1	1.6	2	3.5	0	0
	Improvement	2	9.1	12	19.1	7	12.1	0	0
	Healed	0	0.0	36	57.1	43	74.1	6	100
	Dead	16	72.7	14	22.2	6	10.3	0	0
	Total	**22**	**100.0**	**63**	**100**	**58**	**100**	**6**	**100**
20	Slaughtered	4	18.2	1	1.6	2	3.5	0	0
	Healed	1	4.5	46	73	50	86.2	6	100
	Dead	16	72.7	16	25.4	6	10.3	0	0
	Improvement	1	4.5	0	0	0	0	0	0
	Total	**22**	**100.0**	**63**	**100**	**58**	**100**	**6**	**100**
Treatment cost/animal (F CFA)		0		2980 (315)		3446 (290)		1750 (0)	
Treatment cost in $USD		0		4.95 (0.5)		5.72 (0.5)		2.42 (0.5)	

*** Owners sacrificed some patients in extremis without notifying treatment team. Numbers in parentheses indicate standard errors**

In addition, owners killed some patients without notifying the experiment monitoring officer. After 20 days of treatment, healing rate was very high in batches 2, 3 and 4 having received treatments, compared to high patients' mortality in the control batch.

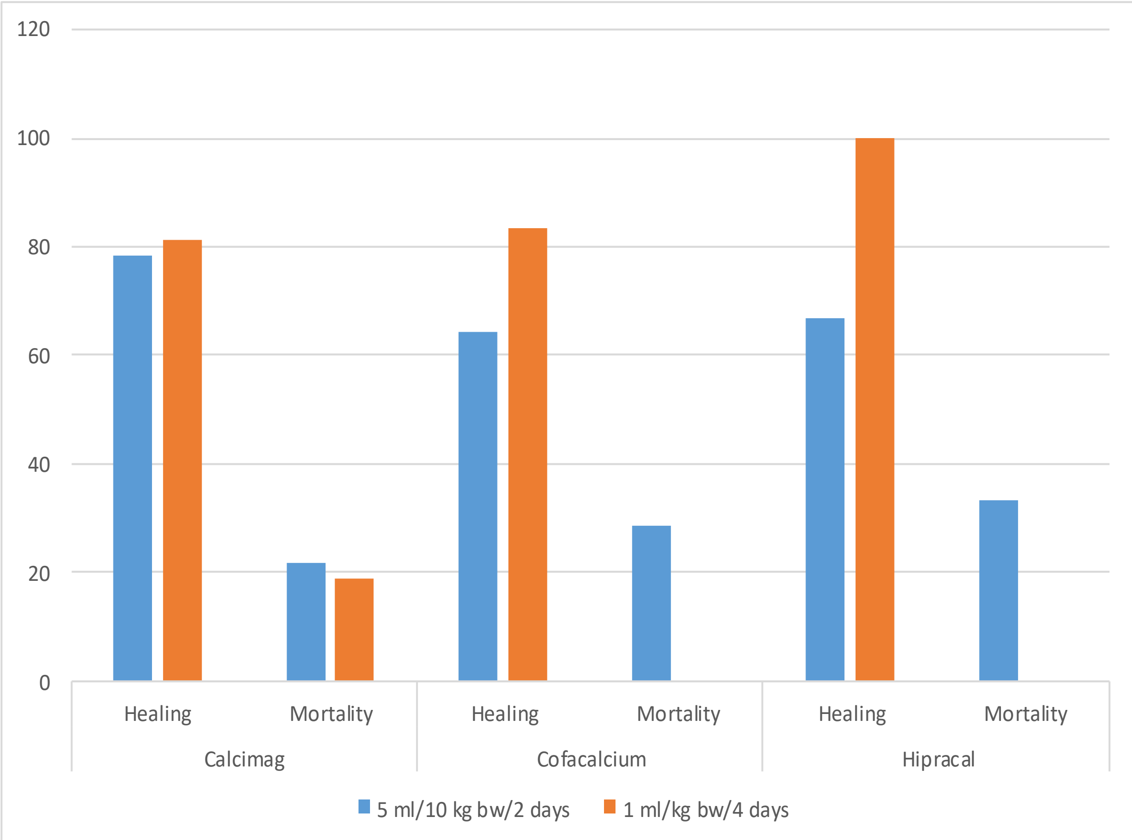
The cost of treatment per animal was relatively low and varied between 1,750 F CFA and 3,446 F CFA or 2.42 and 5.72 $ US depending on the amount of drug used.

The three products used were effective in treating the disease (graph 1). Healing rate obtained with the different doses of calcimag was similar, while for cofacalcium and hipracal, this rate was higher with 1 ml / kg bodyweight dose of animals every 4 days compared with 5 ml / 10 kg bodyweight dose every two days as indicated on the label.

Discussion

Fodder composition

Average fodder protein content was 4.5% (1.06 - 13.06%). This low rate of total nitrogenous matter in the fodder of natural rangelands confirms previous studies conducted in the Sahelian zone such as Lambourne et al (1983) whose results varied between 3.7% and 23.1%. However, despite this low rate, animals do select feed whose ingested portion contained a crude protein level varying between 7.6% and 23.6%. Penning de Vries and Djiteye (1991) reported that maximum use of natural range biomass is achieved when the nitrogen level is 1.5% or 9.34% crude protein. Therefore, animals from the study area must make a strong species selection to gain an optimal level of protein. Dicko (1980) has reported that grazing time is inversely related to fodder availability. In addition, Lambourne et al. (1983) reported that under traditional herd management conditions in the Sahel, the need for energy maintenance increases by 42%, while quantity of ingested dry matter is strongly correlated (r =0.89) with the level of crude protein in feed (Dicko, 1980; Lambourne et al., 1983). Furthermore, Demarquilly and Weiss (1970) indicated that the digestible protein content becomes zero when the crude protein content drops to 3.8% or less than 0.6% nitrogen. Therefore, given all this information and the protein level found in the feed, it is obvious that animals in the study area were in a difficult nutritional situation.



Graph 1: Results of treatments of animals with calcimag, cofacalium and hypracal at two doses

Biochemical profile of plasma

Total proteins

The proteinemia varied between 71.1 and 81.6 g / l with an average of 71.3 g/l. The absence of a significant difference between clinically healthy animals on the one hand, healed animals, and patients on the other hand indicate that this variable cannot be taken as a criterion in the disease differential diagnosis. The interval obtained here is comparable to that of Petit and Queval (1973) in Chad which varied between 71.97 and 74.36 g / l. Blancou et al. (1974) found a value that varied between 80 and 90 g / l in Madagascar, which was higher than the present results. These are also lower than the 81 - 86 g / l (Sawadogo et al. 1991) and the 78 g / l (Sawadogo et al. 1993) in Senegal. Boudergues and Calvet (1971) found 88.2 g / l in January and 72.7 g / l in July. July finding is comparable to the present results, but that of January is higher. Labouche (1964) indicated that total serum proteins content of tropical animals varied between

64.5 and 89.2 g / l, while indicating that several factors such as season (feeding conditions), gestation, breed, age may have influences. However, Abouna (1990) did not observe any statistical difference between non-weaned calves (83 ± 10 g / l), weaned calves (84 ± 7 g / l) and adults (87 ± 9 g / l) among the Goudali and Choa breeds of Cameroon. The fact that our results are lower than those of these authors indicates the probable existence of a nutritional problem in the current study area.

The albumin content which varied between 32.2 and 40.4 g / l is comparable to 33 g / l of Sawadogo et al. (1993), and to 34.89 g / l of Petit and Queval (1973) and to 39 g / l (Sawadogo et al.,1991).

Globulin concentrations varied between 35.9 and 37.5 g / l. Labouche (1964) reported globulin concentration norm in Senegalese cattle varied between 50 and 55 g / l, which is significantly higher than the present results. Globulin low concentrations may be due to area animals under nutrition or to other factors needing clarification.

The alpha globulin concentration fluctuated between 8.2 and 10.4 g / l. These values are comparable to 9 g / l (Sawadogo,1993), but are lower than the 12.2 g / l (Sawadogo et al., 1991), and 14.78 g / l (Petit and Quéval, 1973). The beta globulin content varied between 6.2 and 8.8 g / l, which is lower than the 22.63 g / l (Petit and Quéval,1973) and the 16 g / l (Sawadogo et al.,1991) , but comparable to 8 g / l (Sawadogo et al,1993).

The gamma globulin fraction varied between 18.0 and 21.8 g / l. These values are lower than those of Sawadogo et al. (1991) which was 25 ± 6 g / l, 28 ± 4 g / l (Sawadogo et al.,1993) as well as 28.03 g / l (Petit et Queval, 1973).

Low gamma globulin samples concentration could indicate the absence of microbial infections in animals at the time of collection.

The albumin / globulin ratio fluctuated between 0.93 and 1.07. This ratio is greater than that of Petit and Queval (1973) which varied between 0.54 and 0.56, as well as the 0.76 ± 18 (Sawadogo et al., 1993). Labouche (1964) reported values that ranged from 0.37 to 0.72, while those of Abouna (1990) varied between 0.60 and 0.75), which are lower than the present results. Futures research are needed for understanding the factors that might explain these differences.

Calcium

Calcium serum content varied between 2.25 and 2.67 mmol / l. Current results are higher than those of Zebu Choa (2.16 - 2.32 mmol / l) and lower than zebu Goudali (4.1 - 4.9 mmol /l) of Cameroon (Abouna, 1990). Friot and Calvet (1971) found an average content of 92.5 mg / l (88.6 - 95.1 mg / l), i.e. 2.31 (2.21 - 2.37 mmol / l) in Casamance during the dry season in Senegal, against 88.4 mg / l (84.3 - 98.9 mg / l or 2.20 mmol (2.10 - 2.47 mmol / l) in Ferlo in Senegal. Sawadogo et al. (1991) found a comparable value (2.35 mmol / l). These values are closer to the minimum value of this study. But, current study values are among reference values range indicated by the EISMV (nd) which vary between 2.25 and 3.00 mmol / l.

Phosphorus

Phosphorus serum levels varied between 1.38 mmol / l and 1.68 mmol / l. These values were lower than those reported by Abouna (1990) on Goudali (2.07 mmol / l) and Choa (2.08 mmol / l) zebus in Cameroon and those from Friot and Calvet (1971) in Ferlo, in the rainy season (66.0 mg / l or 2.13 mmol / l and 71.5 mg / l or 2.31 mmol / l, in Senegal. They are close to 49.4 mg / l or 1.59 mmol / l in the dry season in Ferlo, but lower than that obtained by these authors in 1973 (62.1 ± 0.9 mg / l or 2.0 ± 0.02 mmol / l). Habumuremyi (2007) found an average of 2.18 ± 0.93 in animals without pica and 1.93 ± 0.70 mmol in those with pica in Burkina Faso, which is higher than the present results. The present results are also lower than those of Sawadogo et al. (1991) in Senegal. These results confirm the low phosphorus level observed by Kouyaté et al. (1990) in the Malian Sahel. However, EISMV (nd) indicated that the reference values of phosphorus serum content are between 1.30 e t 2.10 mmol / l which fall within this study range.

Magnesium

Magnesium serum content varied between 1.07 and 1.77 mmol / l, which are close to the average (26.4 mg / l or 1.08 ± 0.01 mmol / l) obtained by Friot and Calvet (1973) in Senegal. However, these authors found in 1971, contents varying between 22.8 ± 0.9 and 25.7 ± 3.7 mg / l or 0.94 ± 0.07 and 1.06 ± 0.16 mmol / l, which are slightly lower than the present study findings. On the other hand, the findings of the present study are in the range of Habumuremyi (2007) values who reported an average of 0.91 ± 0.37 with values varying between 0.11 and 2.12 mmol / l in Burkina Faso. However, EISMV (sn) reported that the concentration reference varies between 12 mg / l and 35 mg / l, ie 0.49 mmol / l and 1.44 mmol / l, which is lower than the present results. Sawadogo et al. (1988) indicated the usual serum value of Mg is 18.2 ± 0.3 mg / l or 0.75 ± 0.01 mmol / l, which also is lower than those of the present study. Therefore, these values indicate that magnesium may not a constraint in the study area.

Zinc

Zinc Serum concentration fluctuated between 2.8 and 3.37 µmol / l. These values were lower than the 1.27 to 2.21 mg / l or 19.42 to 33.8 µmol / l observed by Friot and Calvet (1971). They were also lower than the 1.46 ± 0.03 mg / l or 22 , 33 ± 0.46 µmol / l reported by Friot and Calvet 1973) in Senegal, as well as those of Faye et al.(1986) on Ethiopian cattle (113.5 µg / 100 ml - 86 - 136 µg / 100 ml) i.e. 17.4 µmol / l (13.15 - 21.12 µmol / l). Sawadogo et al. (1988) indicated that the usual Zinc concentration in serum is 0.93 ± 0.02 mg / l or 14.22 ± 0.31 mmol / l in adult cattle, while Friot and Calvet (1973) indicated that European standards are between 0.60 and 1 mg / l, i.e. 9.18 and 15.29 µmol / l. Under these conditions, animals in the study area have zinc deficiency.

Copper

Copper serum varied between 2.18 and 2.69 µmol / l with an average of 2.68 ± 0.06 µmol / l. These values are lower than the 64.4 µg / 100 ml or 86 - 136 µg / 100 ml) or 10.16 µmol / l and 7.55 - 11.8 µmol / l found by Faye et al., 1986) on cattle in Ethiopia.

There were also lower than the results of Friot and Calvet (1971) values in Senegalese regions: 0.51 ± 0.13 mg / l or 8.2 ± 2.05 µmol / l in Ferlo in the dry season, 0.62 ± 007 mg / l or 9.76 ± 1.10 µmol / l in the dry season and 0.5 ± 0.05 mg / l or 7.87 ± 0.79 µmol / l in Casamance. Sawadogo et al. (1988) indicated that the usual value for serum concentration of cupper is 0.72 ± 0.02 mg / l or 11.33 ± 0.47 mmol / l in adult cattle. In the other hand, Friot and Calvet (1973) indicated that the threshold for copper deficiency is 0.60 mg / l or 9.44 ± 0.16 µmol / l, while, the contents are between 0.75 and 1 mg / l or 11.80 and 15.74 µmol / l. Consequently, the animals in the study area suffer from copper deficiency, but more investigations should be conducted.

Autopsy findings

The main feature of cattle paralytic syndrome signs discovered in this study is the joint erosion of the forelimbs cartilage, especially the forelimbs. Previous studies (Kouyaté et al., 1988, 1995) have not reported this finding. In the absence of very expensive laboratory analysis, it is possible to diagnose the syndrome based on this characteristic on dead or slaughtered animals.

Trial 2

The patients healing rate treated with injectable solutions was 73% with 5 ml / 10 kg bodyweight dose, 86.2% with 1 ml / kg bodyweight dose and 100% with the lick stone. The 1 ml / kg bodyweight dose, administered every four days, is easier in practice, since it requires less veterinarian presence. These results indicate that the disease is indeed of mineral origin specially calcium and phosphorus, even if the levels of deficiencies have not yet been established. Treatment costs with veterinary products is relatively accessible to cattle breeders.

Results obtained in this study also make it possible to reject the hypothesis of botulism in the study area, contrary to what was reported in Ferlo in Senegal in the 60s and 70s (Calvet et al., (1965). Early clinically manifesting animals and in non-acute forms, the lick stone could save animals, but in the more serious forms, injections are essential. Treatment of mineral deficiencies is well documented in the literature. McDowell (1997) has therefore suggested several treatment methods according to deficiency types. In Senegal (Calvet et al., 1976;, Fall et al., 1999) used natural mineral salts such as phosphates or other sources of minerals to treat animals suffering from mineral deficiency. These methods could also be used in Mali, especially in the northern part of the country which is quite rich in phosphates. However, injectable products use is still valid in disease critical cases.

Conclusion

Cattle paralytic syndrome, observed in Mali since the 1985s, without identification of the real cause, is of mineral origin. Veterinary injectable products treatment used confirms that minerals in question are calcium, phosphorus and magnesium. In severe disease forms, doses of 0.5 ml / kg one day apart or 1 ml / kg bodyweight three days apart is recommended to the extension services pending other products availability. In non-acute forms, access to a quality lick containing calcium, phosphorus and magnesium helps to heal sick cattle. Cattle owners must be more informed and should be aware of awareness by the technical services to combat this disease. Otherwisse, other researches must to be conducted in order to clarify copper and zinc situation in the study area.

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