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SULPHUR DEFICIENCY IN DAIRY CALVES REARED ON PASTURE OF *Brachiaria decumbens*

DEFICIÊNCIA DE ENXOFRE EM BEZERROS LEITEIROS MANTIDOS EM PASTAGEM DE *Brachiaria decumbens*

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SUMMARY

The clinical picture of sulphur (S) deficiency is described by the first time in Brazilian dairy calves. Twelve crossbred six-month-old weaned dairy calves, reared on pasture of S-deficient ***Brachiaria decumbens****, were used. The calves were randomly assigned in two groups of six calves each to verify the influence of S supplementation on some clinical and serum biochemical variables. All animals were fed a basal-supplement mix containing macro and microlements, urea and ground corn grain added (41gS/kg) or not of S (elemental S; 1g S/kg), for six months. At the end of the experiment, the S-supplemented calves had higher mean body weight ($p < 0.01$), body condition score ($p < 0.016$), serum inorganic sulphate concentration ($p < 0.001$) and serum albumin concentration ($p < 0.01$) than the S-deficient calves. The unsupplemented dairy calves exhibited loss of body condition, retarded growth, weight loss and slight apathy.*

Key words: *sulphur, sulphur deficiency, calves,* ***Brachiaria decumbens****, Brazil.*

RESUMO

São descritos, pela primeira vez no Brasil, os sinais clínicos de bezerros leiteiros com deficiência de enxofre (S). Doze bezerros mestiços, recém-desmamados e com seis meses de idade, foram distribuídos, ao acaso, em dois grupos iguais. Todos os animais pastejaram em piquetes de ***Brachiaria decumbens*** *e receberam, por seis meses, um suplemento básico contendo macro e microelementos, uréia e fubá, contendo 1gS/kg. No segundo grupo, essa mistura era suplementada com S-elementar para conter 41gS/kg. Ao término do experimento, o grupo suplementado com S apresentou um maior ganho de peso ($p < 0,01$), melhor condicão corporal ($p < 0,016$), e maiores concentrações séricas de sulfato inorgânico ($p < 0,001$) e de albumina ($p < 0,01$) que os bezerros não suplementados. Os animais deficientes em S apresentaram perda de condição corporal, retardo de crescimento, perda de peso e discreta apatia.*

Palavras-chave: *enxofre, deficiência de enxofre, bezerros,* ***Brachiaria decumbens****, Brasil.*

INTRODUCTION

Brazil has large areas of savannah with acid and low-fertility soils. Usually, these soils are very deficient in some essential elements, such as: phosphorus, sulphur, copper, zinc etc. A large extension of the Brazilian savannah has been used for cattle production. ***Brachiaria*** spp grasses, mainly ***B. decumbens***, very well adapted in those low-fertility soils producing a large amount of dry matter per area, being at the present time one of the most grasses in use. Nevertheless, cattle reared on these grasses can exhibit several mineral deficiencies if an adequate mineral supplementation is not fed (PEDREIRA, 1986).

Sulphur (S) is an essential element to ruminants and plays an important role in the synthesis of S-amino acids, methionine and cystine, needed for ruminal microbial growth. Sulphur is also involved in vitamin synthesis (thiamine, biotin) and coenzymes in the rumen (McDOWEEL, 1985).

A S-deficient diet can decrease the cellulose and organic matter fermentation in the rumen as well as the microbial protein mass available in the intestine to the ruminant (MORRISON ***et al.***, 1990). Thus, cattle with S deficiency can show a clinical picture similar to that produced by protein deficiency, such as: hiporexia, slow growth, loss of body weight, drop in milk

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production, lacrimation, emaciation, weakness and death. The S requirement of grazing cattle reared in warm climates can be met by supplying 0.2% S in the diet (McDOWELL, 1985).

The higher the crude protein content in the grasses, the greater their S level (BARRETO JÚNIOR, 1996). Temperate grasses generally contain more crude protein than tropical grasses. Thus, S deficiency is rarely detected in livestock raised in temperate countries. However, deficiency may be widespread in cattle from tropical countries. The tropical forages may contain low levels of S caused by leaching of the sulphate salts from the soil by the high rainfall and the highly soluble nature of most S in these soils. Concurrently, the S content of the soil would decrease by the extensive use of burning the pastures to the ashes that causes volatility in 75% of their S content (McDOWELL, 1985). Indeed, some Brazilian studies found out very low levels of S (< 0.1% S in the dry matter) in at least 30% of some tropical grasses analysed, principally during the dry season (GALLO ***et al.***,1974, CAVALHEIRO & TRINDADE, 1992; BARRETO JUNIOR, 1996). This last study monitored the S status of cattle fed exclusively on subtropical pasture (***Brachiaria*** spp), through the plasma inorganic sulphate levels. Adequate, marginal and deficient S status were found in 21%, 58% and 21% of the animals, respectively. Although this work reported the presence of S deficiency in cattle, no studies were carried out to compare the effects of S supplementation concomitantly, as well as no clinical signs were described in Brazilian cattle with this deficiency. The objective of this study was to describe the influence of supplementation or not of S on the clinical picture and some blood biochemical values in dairy calves reared on S-deficient ***Brachiaria decumbens*** grass, during the dry season.

MATERIAL AND METHODS

The experiment was carried out in a dairy farm in the municipality of Alumínio, state of São Paulo, Brazil, between 15 March and 15 September 1998. This farm was selected based on a previous study that detected low S status in cattle and forage (BARRETO JÚNIOR, 1996).

Twelve, six-month-old, recently weaned Jersey-Gir crossbred calves were used. At the weaning, the calves were divided, randomly, in two different groups with similar body weight. All animals were allowed to graze during the daylight five paddocks of one hectare each of well-established ***B. decumbens*** grass, throughout the experiment. Daily, at 6 p.m. the animals were divided according to their treatments in two different barns. There, they were supplied with a basal-supplement mix offered free-choice in a feeding trough (1m long X 40cm width X 30cm deep). This basal-supplement mix offered to group 1 contained no specific source of S, with the following formula per kilogram: 200g ground corn grain, 200g urea, dicalcium phosphate 280g, sodium chloride 216g, magnesium oxide 20g, dried molasses 64g, trace elements premix 20g (Zn 3,600ppm; Cu 1,500ppm; Co 200ppm; I 150ppm; Se 12ppm). This basal-supplement mix supplied only 1.0g S/kg DM since Cu and Co were sulphate salts and the dried molasses and the ground corn grain contained 0.47% S and 0.11% S, respectively.

The group 2 was supplemented with 40g of elemental S (flower of sulphur) added to 960g of the basal-mineral mix, previously described. This supplement supplied about 41g S/kg DM. The recommendations for adequate conservation and intake of the mineral supplements by the calves, described by ORTOLANI (1999), were followed. The supplement mix intake was recorded fortnightly. Water was offered ad libitum for both groups. Its S content was negligible. Ten days before the beginning of the experiment, the animals were treated with anthelmintic (avermectin) and vaccinated against foot-and-mouth disease. Three months later, the calves were treated again with anthelmintic. The animals were weighted at the beginning, at the 90th day and at the 180th day of the experiment. Access to water and pasture was denied for 16h prior to these weightings. Body condition was assessed by a 6-point scale (0 to 5) system described by WRIGHT & RUSSEL (1984). The animals were handled on the back region to detect the tissue cover over the transverse processes of the lumbar vertebrae; 0.5 grade was considered between two whole grades.

Blood samples were collected on the same days of the weightings. Blood serum was analysed for inorganic sulphate, urea, protein and albumin concentration. Serum inorganic sulphate was determined according to a technique described by KRIJGSHELD ***et al***. (1979). Serum urea, protein and albumin were determined by techniques described elsewhere (BRITO, 1998). Standard methods were used for determination of chemical composition of the samples of ***B. decumbens*** grass collected throughout the experiment (A. O. A. C. ,1985).

Differences between and within treatments were compared by analysis of variance with the application of the Duncan's multiple range test to compare the means (SNEDCOR & COCKRAM, 1967).

RESULTS

The average chemical composition of ***B. decumbens*** grass collected throughout the experiment is presented in table 1. The mean daily supplement mix consumption throughout the experiment were 70 ± 25g and 83 ± 32g for S-unsupplemented and S-supplemented dairy calves, respectively. No differences were observed in the supplement mix consumption between both groups ($p > 0.38$). The mean body weight and the body condition score are presented in table 2. Lower mean body weight ($p < 0.01$) and body condition score ($p < 0.016$) were detected in the day 180 in calves fed S-deficient diet than in the S-supplemented group. Within the S-unsupplemented and the S-supplemented group lower body condition ($p < 0.03$) and higher body weight ($p < 0.02$) were recorded, respectively, at day 180 as compared to day zero.

The mean serum sulphate, total protein and albumin concentration are shown in table 3. The mean serum sulphate concentration was higher in the S-supplemented group than in the S-unsupplemented ($p < 0.0001$) on day 90 and 180. The S supplementation increased the serum sulphate concentration from day zero to day 90 and 180 ($p < 0.0004$). Conversely, lack of supplementation resulted in a progressively decreased in the serum sulphate concentration ($p < 0.05$) throughout the experiment in the control group. No differences were detected in the serum total protein and urea concentration throughout the experiment ($p > 0.34$). Lower serum albumin concentration was detected in the S-unsupplemented calves at day 180 as compared to the S-supplemented group ($p < 0.01$) and to its serum albumin concentration detected at day zero ($p < 0.012$).

Table 1 - Average chemical composition (%) of ***Brachiaria decumbens*** grass of the paddocks used in the experiment.

(%)	March*	June*	September*
Dry Matter	33.8	47.1	45.2
Crude Protein	6.2	5.3	4.2
Ash	7.2	7.3	7.5
Acid Detergent Fiber	35.3	38.4	41.2
Neutral Detergent Fiber	77.7	79.3	79.2
Ether Extract	2.2	2.1	2.0
Calcium	0.38	0.42	0.52
Phosphorus	0.10	0.07	0.04
Sulphur	0.10	0.08	0.07

* Mean of six samples.

Table 2 - Influence of sulphur supplementation on the mean body weight and body condition of the dairy calves throughout the experiment.

	Mean Body Weight (kg)		
	0	90d	180d
S-Supplemented	101 ± 9 B	114 ± 12AB	121 ± 9 B a
Control	105 ± 7	109 ± 6	99 ± 10 b
	BODY CONDITION SCORE		
S-Supplemented	2.9 ± 0.4	3.1 ± 0.4	3.1 ± 0.2a
Control	3.1 ± 0.4A	2.9 ± 0.2AB	2.4 ± 0.4 Ab

Means in the same column with different lowercase superscripts differ.
Means in the same row with different uppercase superscripts differ.

DISCUSSION

Sulphur deficiency was clearly demonstrated in the unsupplemented calves fed ***B. decumbens*** grass as evidenced by the low serum inorganic sulphate levels at the end of experiment (Table 2). The inorganic serum sulphate levels of the S-supplemented calves were within the normal values (0.38 to 1.78mMol/ℓ) established for healthy cattle by KENNEDY & SIEBERT(1972), whereas the serum sulphate concentration of the control group at day 180 was 45% less than the lower limit of these normal values.

The S requirement of cattle grazing tropical grasses is 0.2% (McDOWELL, 1985). Considering the basal-supplement mix intake and assuming that the roughage ingested is about 2.55% of the calves' body weight, the S intake was 0.21% and 0.08% in the supplemented and deficient groups, respectively. Considering the same assumptions the overall nitrogen:sulphur (N:S) ratios of the diets were 10.4 and 12.6 for the S-supplemented and S-deficient calves, respectively. Both ratios values are within the requirements for cattle. Although the S-deficient calves received adequate N:S ratio the total S intake was insufficient to provide the rumen microbes enough S for maximum growth (SMITH, 1984).

The S-deficient calves developed at the end of the experiment uncharacteristic and non-specific clinical signs such as slight apathy, loss of body condition and weight loss. Other clinical signs, described by McDOWELL (1985), such as lack of appetite, intense weight loss, weakness and lacrimation, were not observed. These cited clinical signs are more likely to develop in sheep than in cattle. The S requirement of cattle is lower than sheep, since there is a great need for S-amino acids in wool production, and sheep recycle lower amounts of sulphate to the rumen, through the

Table 3 - Influence of sulphur supplementation on the mean serum sulphate, total protein, albumin and urea concentration of the dairy calves throughout the experiment.

	0d	90d	180d
	SERUM SULPHATE (mMol/ℓ)		
Supplemented	0.37 ± 0.05 B	0.70 ± 0.07 A a	0.74 ± 0.1 A a
Control	0.38 ± 0.05A	0.30 ± 0.06 B b	0.21 ± 0.02 C b
	SERUM TOTAL PROTEIN (g/ℓ)		
Supplemented	67.5 ± 3.2	67.2 ± 3.1	67.3 ± 3.1
Control	69.0 ± 3.6	68.4 ± 3.2	68.5 ± 3.7
	SERUM ALBUMIN (g/ℓ)		
Supplemented	31.2 ± 2.2	31.0 ± 1.4	31.6 ± 1.1 a
Control	31.0 ± 1.9A	29.8 ± 1.1 AB	26.6 ± 1.7 Bb
	SERUM UREA (mMol/ℓ)		
Supplemented	3.7 ± 0.3	3.9 ± 0.5	3.8 ± 0.4
Control	3.4 ± 0.5	3.6 ± 0.4	3.2 ± 0.4

Means in the same column with different lowercase superscripts differ.
Means in the same row with different uppercase superscripts differ.

saliva, reducing the S incorporation into microbial organic matter (KENNEDY & SIEBERT, 1972).

Sulphur supplementation promoted a slight but significant body weight gain as compared to the unsupplemented calves (Table 2). This experiment showed that S by itself can be an important limiting nutrient to the development of growing calves reared on subtropical areas, principally during the dry season when the grasses become poorer in S and protein and decrease their quality and digestibility. Better cellulose digestion, increased number of rumen bacteria, protozoa and anaerobic fungi and high level of propionate were observed in sheep fed poor-quality tropical grass supplemented with S. Moreover, diets supplying adequate S tend to result in higher retention of N and S (MORRISON ***et al.***, 1990; KENNEDY & SIEBERT, 1972).

Although the forage intake was not measured in this experiment it might be possible that higher consumption has occurred in the S-supplemented calves. Steers fed low protein tropical grass had a higher feed intake when they were supplemented with S (KENNEDY & SIEBERT, 1972). The ***B. decumbens*** grass available to the dairy calves had a progressive decreasing levels of crude protein as well as of S (Table 1). Further studies are necessary to compare the forage intake in calves supplemented or not with S.

Serum albumin concentration was significantly lowered when S-deficient diet was given (Table 3). Early study found that cysteine and methionine presented in the body protein of a cow showed appreciable radioactivity following the radioactive sulphate intake. (BLOCK & STERCOL, 1950). Thus, the long-lasting effects of the S deficiency might have led to a lower albumin production, but not of the globulin. Serum globulin and serum albumin correlate inversely. Both proteins contribute to homeostatic control of blood osmotic pressure; a mild hypoalbuminaemia requires a corresponding increase in the globulinaemia (PAYNE & PAYNE, 1987). Thus, the sum of both proteins would keep the total protein apparently unchanged. The hypoalbuminaemia is also correlated with decreased growth of muscle in rearing stock (PAYNE & PAYNE, 1987). The S deficiency besides causing hypoalbuminaemia inflicted a lower body condition score in the calves. The serum urea concentration was not affected by the different S intake (Table 3). Probably, this was caused by the similar intake of nitrogen since both groups ingested comparable amount of urea. Even tough, controversial results were obtained in the serum urea concentration of sheep fed or not S-deficient diets (KENNEDY & SIEBERT, 1972; MORRISON ***et al.***, 1990).

This experiment showed that S can be a limiting factor to the development of growing calves reared on pastures of ***Brachiaria decumbens*** throughout the dry season. Further studies are necessary to know the extension of S deficiency in the forages and principally in the cattle raised in different Brazilian regions, since limited responses in performance to N or P supplementation of tropical forages may be observed if S is not also supplied to cattle (SMITH, 1984).

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