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Mineral Imbalances in the Complex Interactions Soil-Plant-Animal in the Grasslands of Center-West Region of the São Paulo State, Brazil

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Abstract: This study was conducted to analyze the mineral composition of forage plants used for beef cattle in nine regions between the years 1984-1992 and clinical observations of animals stretched to date (2009). The forage *Brachiaria decumbens* used in cutting farm was studied during the four seasons of the year writing the collection of sampling the twelve months of the year. We used a completely randomized design with three replicates per season and each of the nine municipalities studied, resulting in the total sample of 108 samples of forage grasses to evaluate the behavior of the macroscopic Ca, P and Mg and trace elements Cu, Zn, Fe, Mn and Co from the analysis by atomic absorption spectrophotometry, except the P by molecular absorption spectrophotometry of forage available for grazing cattle during the seasons spring, summer, autumn and winter. Still, we sampled animal tissue (liver) and soil to determine the mineral profile. The percentage variation in averages were: Macro 0.36-0.40 g% Ca, 0.05-0.10 g% P, 0.14-0.20 g% Mg. Microminerals: 30-40 mg% Zn, 3-8 mg% Cu, 0.06-0.09 mg% Co and 40-80 mg% Mn. These results showed that when adjusting the requirements of protein and energy supplementation through matter, all small macro: Ca, P and Mg and trace elements Cu, Co and Zn must also be supplemented at all times or the seasons second category animal growth, reproduction and lactation. The concentration of macro: 485.33 mg% Ca: 9011.11 mg% P, 317.17 mg% Mg and trace minerals in liver varied: 152.38 mg% Cu, 219.67 mg% Zn, 6.36 mg% Mn; 260.18 mg% Fe and 0.132 mg% Co. The main clinical signs and symptoms observed in the properties: fibrous osteodystrophy, rickets, osteomalacia , infertility, excitability, loss of appetite, anemia, reduced growth, Achromotrichia, heart failure, bones that are fragile and easily fractured, diarrhea, infertility and anestrus, low fertility, abortion, stillbirth and low birth weight, lesions of parakeratosis and tetany pastures. Clinical signs of deficiencies of macro and micro minerals in the animals ceased with the effect of mineral supplementation led to animals with deficiencies of macro and trace elements in forage diagnosed.

Key words: Forage plants, deficiencies of macro minerals, deficiencies of micro minerals

INTRODUCTION

Deficiency or privation of macro or macrominerals is commonly diagnosed in cattle receiving sole source of nutrients, the grass. Besides affecting the productive performance of animals, vegetarian diet deficient in various nutrients can have adverse effects on the organic whole. On the other hand, during disease states trace mineral requirements may be affected by immune system response. High concentrations of zinc have been shown to be beneficial to the animal's health during disease and Zinc (Zn), Copper (Cu), Selenium (Se) and Iron (Fe) seem to be necessary for immunocompetence (Underwood, 1977; NRC, 1996).

Pathological manifestations of deficiency or toxicity of trace elements can be observed since they are components of metaloenzyme such as Mn and Zn. Known as limiting factors or "trace" for the elements present in such small quantities in living tissues could not be measured with available methods and elements appearing in the body, 10 were designated as "essential" trace elements: zinc, manganese, copper, iodine, iron, cobalt, molybdenum, tin, selenium and chromium (McDowell, 1992). Iodine is closely associated with the physiology of the thyroid, cobalt is a component of vitamin B_{12} and iron is both a component of hemoglobin and closely related to the cytochrome system. Among the seven essential trace elements, zinc, manganese and copper have been studied more extensively. Deficiency characteristic of an element essential trace results in a syndrome in a manner similar to a vitamin deficiency or hormonal. The syndrome is associated with certain structural abnormalities, functional, biochemical or physiological. These changes, in turn, are prevented or reversed after administration of trace element deficient (Conrad *et al*., 1985; Van Soest, 1994; Paulino *et al*., 2004).

The general pattern of deformities seen in deficiencies of trace elements varies mineral involved as part of enzymatic processes and tissue formation. Thus, the deficiency of manganese and zinc results in prejudice to the synthesis of enzymes depends on and in the formation of cartilage seen in birds (perosis), rats and guinea pigs (otoliths) and newborn calves (twisting leg abnormalities of the members). Congenital disorders

and other malformations of tissues has been frequently observed in many animal species.

Additionally, deficiencies such as Mn for the lack of research evidence on the role of Mn in the diet for participating in the synthesis of nucleic acids, use of glucose and neogluconeogenesis, intermediary metabolism and function endrocrine gland (McDowell, 1992).

The nutrient requirements must meet the predicted value for beef cattle according to animal performance, environmental and feeding conditions. Protein, energy, minerals and vitamins are mainly dependent variables of Body Weight (BW) and category - growth, pregnancy, lactation, work and rumen microbial activity (Van Soest, 1994) - to be considered as continuous variables and the interactions with the effects of diet composition (ARC, 1980). However, in the formulations to supply the deficiencies of grass available beef cattle raised in extensive grazing system should be proportional to intake of Dry Matter (DM) and digestibility of Dry Matter (DM), Total Digestible Nutrients (TDN) in DM according to the season of grazing (McDowell and Conrad, 1977; McDowell, 1992).

Accentuate deficiency of P, cobalt, copper and zinc and other elements has been observed in soil and plant in relation to the requirements of herbivorous species. Thus, the pastures in Brazil reveal the prevalence of severe deficiency of Phosphorus (P), Cobalt (Co) between others macro and trace elements of vital importance in nutrition and limiting animal performance (McDowell, 1992; Castillo Estrada, 1996).

Based on plant physiology at the time that the tendency of water to greater P concentration in seeds and green leaves and consequently the dilution factor in dry matter of forage as the forage declines in the production of DM in the dry season of the year (O'Donovan *et al*., 1979; Conrad *et al*., 1985).

Animals created on pasture may show symptoms of general or specific deficiencies of certain mineral (Fernandes and Camargo, 1976). Soil analysis conducted in different regions of Brazil has shown widespread deficiency of P (Lopes *et al*., 1980; Barros *et al*., 1992). The forage available to grazing of beef cattle herd is considered the main source of nutrients for the growth functions, maintenance, milk and meat and reproduction (Pott and Pott, 1987; Moraes, 1998).

The content of protein, carbohydrates, vitamins and minerals is variable in different species available for grazing. Analyzing the physiological behavior of fodder in different seasons of the year, a rule does not meet the requirements of the different categories of the herd. The skeleton of the beef is around 40% of the weight of the carcass and approximately three to four percent of this mineral matter is. Among the macro minerals, Calcium (Ca), Phosphorus (P) and Magnesium (Mg), P deficient soil and consequently in plants. For the main microminerals, Copper (Cu), Zinc (Zn), Manganese (Mn), Iron (Fe) and Cobalt (Co), except for Fe content has proved satisfactory in forage grasses (Gallo *et al*., 1974; Gomide, 1976; Paulino *et al*., 2004). The shortcomings are limiting the exploitation of economic activity. The shortages have been expressed in different ways ranging from the depraved appetite for weight loss and death. Enjoy low rates can lead to frustrate the operation. The deficiency have manifested in different ways ranging from the depraved appetite with weight loss and death (Tokarnia *et al*., 1999; Underwood, 1981; 1983). Lower rates of enjoyment can lead to economically cripple the operation.

From the physiological point of view the remarkable potential of the protein production of grass for beef cattle has been considered satisfactory provided that there is supplementation (Sousa *et al*., 1983; Sousa *et al*., 1985; Sousa and Darsie, 1985). From vegetarian diet only animals are endowed with mechanisms capable of digestion of fibrous plant material transformed into products of high protein, meat and dairy, besides the availability of many of the industry many products available to industrialization (hides, bones, hooves and horns).

Since the grasses the only food available is understood the need for adequacy of dietary supplementation finale (Lana *et al*., 1992; Paulino, 1996; Nicodemo *et al*., 2005).

In deficiency of macro and trace elements, animals have many biological and physical symptoms such as decrease of min in the tissues and milk, something less than desirable growth, decreased ovarian and testicular function, accumulation of fat and glucose tolerance curve for glucose.

Thus, the objective of this study was to analyze the mineral content of forage grasses in macro: Ca, P and Mg and trace elements: Cu, Co, Zn, Mn and Fe, soil minerals and clinical follow up the beef cattle raised extensively during the four seasons of the year through the collection of samples of grass available and clinical monitoring of the herd. Evaluation mineral levels in forage grasses for beef cattle grazing in the

MATERIALS AND METHODS

To study the seasonal behavior of the forage in *Brachiaria decumbens* used for grazing cattle in the center-west of the state were randomly selected nine counties represented by Arealva, Duartina, Bauru, Lucianopólis, Cabralia Paulista, Avai, Piratininga and Ubirajara. Samples of the grass *Brachiaria decumbens* were harvested within twelve months of the year to analyze the macro: Ca, P and Mg and microminerals: Cu, Zn, Co, Fe, Mn (AOAC, 1990). The chemical determination of mineral elements was conducted in the Section of Deficiency Diseases and Metabolic Institute Biologico between the years 1984 to 1992 and clinical observations of animals stretched to year of 2009. The Dry Matter (DM) of the standardization sample was

obtained after drying in the oven at 65°C for 24 h with standardization of DM in 90%. After grinding in Wiley mill type knife with stainless steel and free from contamination by minerals, the samples were transferred to Erlenmeyer flask and subjected to acid digestion in a hot plate with the aid of digestor wrapped inside chapel of exhaust gases. The 12 liver samples after crushing and treated with solvents to extract the fat has been kiln dried and mineralized by acid digestion hot. The extract obtained by wet digestion was transferred to volumetric flask and measured the volume with distilled and demineralized water obtained in deionized and distiller apparatus, both with internal circuit entirely of glass. Then the samples were injected into the atomic absorption spectrophotometer Varian brand properly calibrated with standards in reading and hollow cathode lamp specifies the mineral to be analyzed. OP was read by molecular absorption spectrophotometry. The reading obtained for the mineral in question was applied the formula to calculate the concentration according to the volume used in the dilution of concentrated extract obtained.

Statistical analysis: Were used a completely randomized design for sampling 108 the total samples taken in nine municipalities and four distinct seasons, namely: spring, summer, autumn and winter to determine the three main macro: Ca, Mg and P and five microminerals: Cu, Zn, Co, Fe and Mn in grass *B. decumbens* in the region studied. Were applied the model of analysis of variance for difference of mean seasons and regions for each mineral analyzed by SAS software (SAS, 1994). The Tukey test was used at 5% level of difference to study the difference between means of treatments.

RESULTS

Among the studied macro only Ca showed satisfactory average greater than 0.20 g% in DM and the averages of the four stations ranged from 0.36 g% (summer and autumn) to 0.37 g% (winter) and 0.39 g% (spring) did not differ between seasons.

A sampling of the grass *B. decumbens* showed variation in the four seasons of averages of 0.0703 g% (autumn) to 0.0933 g% (spring) representing the difference less than 60% and 65% respectively in the average value of 0,18% DM in the need to beef cattle.

Average lower than 0.18 g% Mg in the DM of the grass *B. decumbens* ranging from 0.15 g% (autumn and winter) to 0.16 g% (spring and summer), representing the smallest difference of 15% and 20%, respectively, were found at stations in the four seasons.

The variation in average 41 mg (autumn) to 49 mg Zn (summer) showed no difference ($p<0.05$) between seasons and were significantly higher than the average of 30 mg Zn/kg DM recommended by the NRC (1980, 1996).

The averages ranged from 81 mg (autumn) to 89 mg Mn (winter) seasons were shown in the average marginal levels of 80 mg Mn considered satisfactory by the NRC (1996). But average of 79 mg Mn/kg DM in *B. decumbens* season in spring.

The element Co, between seasons, showed differences for the measures in the stations studied. The lowest average of 0.08 mg% of Co (summer) different from the average of 0.10 mg% of Co (winter) in DM of the grass *B. decumbens* representing the largest difference of 18% on the summer season (Table 1).

Whereas the average macro: Ca, Mg and P for each regions of the state, totaling 12 samples by region in the four seasons, only the mineral element Ca showed satisfactory content. The content of P ranged from 0.06 g% (Arealva) to 0.09 g% (Cabralia Paulista, Duartina and Iacanga) representing 50% and 60% of application of 0.18 g% P/kg DM for cattle according to NRC (1980, 1984).

Means for Mg ranging from 0.15-0.18 g% showed marginal deficiency on the requirement of 0.18 g% of NRC (1980).

Among the micro, the Cu with average ranging from 3.92 mg (Lucianopólis) to 5.08 mg (Ubirajara) showed deficiency of 25% (marginal) to severe (40%) in forage for applications ranging from 6-10 mg Cu/kg DM according to NRC (1980). The variation of Mn showed averages of 71.33 mg (Lucianopólis) to 93.75 mg (Iacanga) represented the attendance requirements of 80 mg Mn/ kg DM, except for marginal deficiency of 15% and 20%, respectively, for the lowest average of 71 mg (Lucianopólis) and 73 mg Mn/kg DM (Bauru). The element Co showed marginal deficiency of means ranging from 0.08-0.098 mg/kg DM in all cities studied compared with the minimum requirements of 0.10 mg/kg of DM according to the NRC standard (1996). The Zn and Fe showed sufficiency in all municipalities and seasons compared to the standards of NRC (1996) of 30 ppm and 50 ppm, respectively, in *B. decumbens* (Table 2-4 and 8).

The sampling in the months of collection in each region within the time revealed that the medium did not differ between seasons and cities studied for the four seasons: spring, summer, autumn and winter. Except for the elements Ca and Zn sampling showed marginal deficiency for Mg, Mn and Fe and severe disabilities for the P, Cu, Co other minerals analyzed in all regions and seasons analyzed (Table 3 and 4).

The averages of the cities of 0,16 g% Mg (spring and summer) and 0.090 g% P (spring) and 0.080 g% P (summer) did not differ from the average of 0.15 g% Mg (autumn and winter) and 0.070 g% P (autumn) and 0.077 g% P (winter) in the stations studied.

The contents of the microminerals *B. decumbens* in the nine regions with average of 4.78 mg% Cu (spring) and 4.93 mg% Cu (summer), 0.090 mg% Co (spring) and

Table 1: Means, standard deviation and coefficient of variation of the mineral content by four season of year studied

Seasons	Ca	P	Mg	Cu	Zn	Mn	Fe	Co
Spring	0.39[a]	0.09[a]	0.16[a]	4.78[a]	45[a]	79[a]	144[a]	0.09[bc]
Summer	0.36[a]	0.08[a]	0.16[a]	4.93[a]	49[a]	83[a]	130[a]	0.08[c]
Autumn	0.36[a]	0.07[a]	0.15[a]	4.11[a]	41[a]	81[a]	133[a]	0.09[ab]
Winter	0.37[a]	0.07[a]	0.15[a]	4.11[a]	43[a]	89[a]	143[a]	0.10[a]
µ	0.37	0.08	0.16	4.48	44.52	83.26	137.43	0.093
dp	0.01	0.01	0.01	0.43	3.29	4.27	7.23	0.007
cv	20.99	46.12	19.50	28.45	27.73	28.64	36.03	13.92

[1]m = means of analysis of three months of collection of forage for grazing beef cattle.
*Means column with different superscript denote difference ($p<0.05$) significant

Table 2: Means of the mineral content by region in the four seasons of year

Municipality[1]	Ca	P	Mg	Cu	Zn	Mn	Fe	Co
Arealva	0.35[a*]	0.06[a]	0.15[a]	4.83[a]	47.08[a]	82.83[a]	150.08[a]	0.088[a]
Avaí	0.41[a]	0.08[a]	0.17[a]	4.54[a]	45.17[a]	80.75[a]	139.08[a]	0.091[a]
Bauru	0.35[a]	0.08[a]	0.16[a]	4.29[a]	39.50[a]	73.41[a]	131.17[a]	0.093[a]
Cab Paulista	0.40[a]	0.09[a]	0.16[a]	4.21[a]	46.59[a]	88.75[a]	134.67[a]	0.095[a]
Duartina	0.35[a]	0.09[a]	0.15[a]	4.13[a]	42.08[a]	89.58[a]	135.58[a]	0.094[a]
Iacanga	0.37[a]	0.09[a]	0.18[a]	4.17[a]	50.92[a]	93.75[a]	141.67[a]	0.095[a]
Lucianopólis	0.37[a]	0.06[a]	0.15[a]	3.92[a]	41.42[a]	71.33[a]	111.83[a]	0.098[a]
Piratininga	0.35[a]	0.08[a]	0.15[a]	5.17[a]	45.08[a]	82.92[a]	143.33[a]	0.096[a]
Ubirajara	0.37[a]	0.08[a]	0.15[a]	5.08[a]	42.83[a]	86.00[a]	149.42[a]	0.092[a]
µ	0.37	0.08	0.16	4.48	44.52	83.26	137.43	0.093
dp	0.02	0.01	0.01	0.45	3.47	7.36	11.54	0.003
cv	20.99	46.12	19.50	28.45	27.73	28.64	36.03	13.92

[1]µ = Means analysis of three months to collect of forage of grazing of beef cattle.
*Means with same letters in column indicate difference ($p>0.05$) not significant

0.084 mg% Co (summer) did respectively, of mean 4.11 mg% Cu (autumn and winter), 0.096 mg% Co (autumn) and 0.101 mg% Co (winter) in the studied seasons (Table 3 and 4).

DISCUSSION

Prediction equations: To calculate the requirement of macrominerals the NRC (1996) calls the sum of: Calcium: [(maintenance: 0.0154 x (Shrunk PV) + growth: 0.071 x (gain in protein, g/day) + milk production: 1, 23 x (kg of milk/day) + pregnancy last 90 days: 13.7/90)] /0.5; Phosphorus: [(maintenance: 0.016 x (Shrunk PV) + growth: 0.045 x (gain in protein, g/day) + milk production: 0.95 x (kg of milk/day) + pregnancy last 90 days: 7.6/90)] / 0.68.

The supply of requirements of beef cattle in adulthood estimated at 450 kg BW is compromised (Table 5) when the only source of nutrients as energy, protein, minerals and vitamins are agreeing to the pasture and NRC (1980), Pott and Pott (1987) and Fontes (1995). The low quantity and quality of available DM digestibility indicate below the actual requirement of the animals.

From the estimate that the herd is grazing 1% of BW in DM/day, each animal therapy ingested 4.5 kg of DM based on the equation of prediction above would need 13.86 g Ca/day (0.31 g% Ca) and 10.59 g P/day (0.24 g% P). The same class with animal intake 2% of BW in DM/day have ingested 9 kg of DM and to meet the requirement of these minerals will be supplied by the average concentration of 0.16 g% Ca (13.86 g Ca) and 0, 12 g% P (10.59 g P) in DM, can be observed decline around 50% of the concentration of Ca and P in the diet. Table 1, 3 and 4 show the average ($p> 0.05$) of 0.070 g% P (autumn) is registering disability based on the P% DM intake/100 kg of PV: 86% P (0.5% DM), 71% P (1.0% DM) and 42% P (2.0% DM) according to the intake of DM in each category animal. Still, one should take into account in the formulation of mineral supplementation to grazing the gain of muscle mass (gain in protein), milk production and pregnancy. Results and similar observations were made by Sousa *et al.* (1979), Sousa *et al.* (1982), Prada *et al.* (1983) and Tokarnia *et al.* (2000).

The requirement of Ca to: maintenance: 15.4 mg/kg BW, 7.1 g/100 g protein retained; lactation: 1.23 g Ca/kg milk, 13.7 g Ca/kg of fetal PV (3 months gestation) (NRC, 1996).

The results of this study are consistent with Underwood (1977) and Barros *et al.* (1992) to reveal that factors such as species, physiological stage of plant, plant part consumed, the quantity of exchangeable mineral soil and climate directly affect the mineral content available on the plant.

On average the soil (Table 6) and pastures showed P deficiency in all nine regions and four seasons of this research. The need to supplement the herd with mineral mixture containing a source of phosphorus (phosphate rock) throughout the year. Besides the energy and protein deficiencies typical of extensive grazing in the creations, the marked deficiency of mineral P be supplemented to meet the requirement of each animal category (Moraes, 1998; Tokarnia *et al.*, 1999).

Table 3: Means of the mineral content by season of year and for each region studied

Municipality[1]	Ca	P	Mg	Cu	Zn	Mn	Fe	Co
	Spring Season							
Arealva	0.35[a*]	0.056[a]	0.14[a]	5.17[a]	39.00[a]	77.67[a]	180.00[a]	0.083[a]
Avaí	0.42[a]	0.113[a]	0.18[a]	5.33[a]	45.33[a]	102.00[a]	164.33[a]	0.091[a]
Bauru	0.37[a]	0.093[a]	0.16[a]	3.83[a]	45.67[a]	66.67[a]	127.33[a]	0.093[a]
Cab Paulista	0.42[a]	0.126[a]	0.14[a]	4.50[a]	55.00[a]	96.00[a]	147.33[a]	0.091[a]
Duartina	0.40[a]	0.100[a]	0.17[a]	5.00[a]	47.00[a]	92.33[a]	179.67[a]	0.085[a]
Iacanga	0.34[a]	0.110[a]	0.18[a]	4.00[a]	45.00[a]	74.00[a]	98.67[a]	0.083[a]
Lucianopólis	0.43[a]	0.073[a]	0.14[a]	4.00[a]	34.00[a]	67.00[a]	106.33[a]	0.100[a]
Piratininga	0.36[a]	0.056[a]	0.17[a]	5.17[a]	50.67[a]	74.67[a]	146.67[a]	0.100[a]
Ubirajara	0.39[a]	0.110[a]	0.17[a]	6.00[a]	44.67[a]	64.33[a]	145.67[a]	0.085[a]
µ	0.39[A]	0.090[A]	0.16[A]	4.78[A]	45.15[A]	79.41[A]	144.00[A]	0.090[a]
dp	0.03	0.020	0.02	0.74	6.06	13.92	29.06	0.006
cv	23.91	47.55	18.00	27.89	22.20	30.78	35.45	13.28
	Summer Season							
Arealva	0.41[a]	0.070[a]	0.17[a]	6.33[a]	54.33[a]	90.67[a]	141.00[a]	0.073[a]
Avaí	0.37[a]	0.100[a]	0.16[a]	5.00[a]	50.67[a]	75.33[a]	104.67[a]	0.078[a]
Bauru	0.38[a]	0.090[a]	0.14[a]	6.00[a]	34.67[a]	88.33[a]	156.33[a]	0.081[a]
C. Paulista	0.37[a]	0.100[a]	0.18[a]	4.00[a]	52.00[a]	89.33[a]	125.67[a]	0.085[a]
Duartina	0.37[a]	0.086[a]	0.16[a]	3.83[a]	56.33[a]	84.00[a]	133.33[a]	0.086[a]
Iacanga	0.33[a]	0.103[a]	0.18[a]	4.67[a]	51.67[a]	107.67[a]	135.67[a]	0.088[a]
Lucianopólis	0.33[a]	0.056[a]	0.16[a]	3.50[a]	49.67[a]	64.33[a]	111.67[a]	0.090[a]
Piratininga	0.32[a]	0.090[a]	0.17[a]	6.17[a]	36.33[a]	73.33[a]	106.00[a]	0.088[a]
Ubirajara	0.34[a]	0.073[a]	0.15[a]	4.83[a]	53.67[a]	78.33[a]	152.67[a]	0.091[a]
µ	0.36[A]	0.080[A]	0.16[A]	4.93[A]	48.82[A]	83.48[A]	129.67[A]	0.084[A]
dp	0.03	0.010	0.01	1.05	7.82	12.54	19.18	0.005
cv	18.24	44.96	18.52	29.75	24.08	26.34	28.13	10.84

[1]µ = means analysis of three months to collect fodder for the grazing of beef cattle.
*Means the same column with superscript denotes difference ($p<0.05$) significant

Table 4: Means of the mineral content by season of year and for each region studied

Municipality[1]	Ca	P	Mg	Cu	Zn	Mn	Fe	Co
	Autumn Season							
Arealva	0.33[a*]	0.056[a]	0.15[a]	3.83[a]	48.33[a]	79.67[a]	128.00[a]	0.088[a]
Avaí	0.39[a]	0.066[a]	0.15[a]	3.50[a]	40.33[a]	76.67[a]	138.33[a]	0.095[a]
Bauru	0.34[a]	0.076[a]	0.17[a]	4.33[a]	38.00[a]	70.67[a]	135.33[a]	0.093[a]
Cab Paulista	0.38[a]	0.073[a]	0.13[a]	4.33[a]	40.00[a]	81.00[a]	127.33[a]	0.101[a]
Duartina	0.33[a]	0.056[a]	0.13[a]	3.67[a]	31.33[a]	85.00[a]	115.00[a]	0.106[a]
Iacanga	0.37[a]	0.090[a]	0.17[a]	4.00[a]	52.67[a]	70.33[a]	143.67[a]	0.098[a]
Lucianopólis	0.32[a]	0.063[a]	0.16[a]	4.50[a]	29.00[a]	87.33[a]	130.33[a]	0.101[a]
Piratininga	0.35[a]	0.090[a]	0.13[a]	4.67[a]	45.67[a]	70.33[a]	110.67[a]	0.088[a]
Ubirajara	0.40[a]	0.060[a]	0.16[a]	4.17[a]	45.33[a]	108.00[a]	167.33[a]	0.093[a]
µ	0.36[A]	0.070[A]	0.15[A]	4.11[A]	41.18[A]	81.00[A]	132.89[A]	0.096[A]
dp	0.03	0.013	0.02	0.39	7.73	11.94	16.63	0.006
cv	20.51	42.90	21.09	21.42	30.96	23.25	26.95	14.37
	Winter Season							
Arealva	0.31[a]	0.060[a]	0.13[a]	4.00[a]	46.67[a]	83.33[a]	151.33[a]	0.101[a]
Avaí	0.44[a]	0.053[a]	0.19[a]	4.33[a]	44.33[a]	69.00[a]	149.00[a]	0.100[a]
Bauru	0.32[a]	0.066[a]	0.15[a]	3.00[a]	39.67[a]	68.00[a]	105.67[a]	0.101[a]
Cab Paulista	0.41[a]	0.080[a]	0.16[a]	4.00[a]	39.33[a]	88.67[a]	138.33[a]	0.100[a]
Duartina	0.31[a]	0.123[a]	0.15[a]	4.00[a]	33.67[a]	97.00[a]	114.33[a]	0.096[a]
Iacanga	0.43[a]	0.066[a]	0.19[a]	4.00[a]	54.33[a]	123.00[a]	188.67[a]	0.110[a]
Lucianopólis	0.41[a]	0.053[a]	0.15[a]	3.67[a]	53.00[a]	66.67[a]	99.00[a]	0.101[a]
Piratininga	0.35[a]	0.106[a]	0.13[a]	4.67[a]	47.67[a]	113.33[a]	210.00[a]	0.106[a]
Ubirajara	0.32[a]	0.083[a]	0.14[a]	5.33[a]	27.67[a]	93.33[a]	132.00[a]	0.096[a]
µ	0.37[A]	0.077[A]	0.15[A]	4.11[A]	42.93[A]	89.15[A]	143.15[A]	0.101[A]
dp	0.05	0.024	0.02	0.65	8.75	20.01	37.04	0.004
cv	20.47	44.07	20.54	28.89	32.28	32.67	47.92	10.65

[1]µ = means of the analysis of three months of collection of forage in grazing beef cattle. *Means in the column with the same superscript denote no significant ($p<0.05$) difference

The main symptoms of the animals observed in the twelve months were related to P deficiency by the significant role combined with Ca in the formation of bone and teeth. Stoichiometric formula of calcium

Tabel 5: Mineral levels in dry matter (DM) of bovine liver

Municipality*	Ca	P	Mg	Cu	Zn	Mn	Fe	Co
	mg/kg MS							
Arealva	800	-	600	8.20	90	-	246	0.090
Arealva	800	-	500	100.00	70	10	571	0.080
Avaí	700	11000	600	335.00	125	8	232	-
Avaí	120	-	200	75.00	200	8	22	0.165
Bauru	600	8600	200	12.00	94	6	340	0.100
Bauru	120	11000	106	-	78	6	172	0.170
Cabralia Paulista	160	8000	400	42.00	140	4	102	0.150
Cabralia Paulista	800	6000	200	290.00	600	4	-	-
Duartina	280	10500	200	65.00	365	4	148	0.150
Iacanga	400	9000	400	187.00	160	8	272	0.150
Lucianopólis	250	11000	200	272.00	114	8	640	0.130
Piratininga	800	6000	200	290.00	600	4	117	-
µ*	485.83	9011.11	317.17	152.38	219.67	6.36	260.18	0.132

(*) averages sampling

Table 6: Mineral levels in soil of grassland areas

				meq/100 cm^3 T.F.S.A[1].					
Samples	pH	M.O	P						
**	($CaCl_2$)	%	(µg/cm^3)	K	Ca	Mg	H+AL	SB	T
1	4.6	0.8	2	0.12	1.2	0.3	1.8	1.6	3.4
2	4.1	1.1	3	0.02	0.5	0.3	2.5	0.8	3.3
3	3.9	0.9	1	0.02	0.2	0.1	4.2	0.3	4.5
4	4.7	1.8	3	0.07	0.4	0.2	0.7	-	-
		ppm					Exchangeable %		
Samples									
**	V*	B	Cu	Fe	Mn	Zn	K	Mg	Ca
1	47	-	-	-	-	-	3.5	8.8	35.3
2	24	1.66	0.5	125	70	1.3	-	-	-
3	7	1.39	0.3	112	41	0.7	-	-	-
4	-	-	-	-	-	-	-	-	-

*V % recommended: 60% a 70%. [1]T.F.S.A: Earth fine air dried; **1- Lucianopólis; 2-Bauru; 3-Avaí; 4-Duartina

phosphate or hydroxyapatite hydroxide is $Ca_5 (PO_4)_3 (OH)$ and ratio Ca/P ratio to 1.67 or compositions with stable proportion extended to about 1.5. Another compound present is calcium phosphate or apatite: $Ca_5 (PO_4)_2$ extended to about 1.5. Another compound present is calcium phosphate or apatite: $Ca_5 (PO_4)_2$. Several studies (Playne, 1976; AFRC, 1991) demonstrated that rates of dietary calcium and phosphorus between 1:1 and 7:1 resulted in similar performance, provided that the intake of phosphorus is sufficient to meet the requirements. About 80% of phosphorus in the body is found in bones and teeth with the remainder distributed in soft tissues. The Ca required for maintenance was estimated at 15.4 mg/kg BW, while the requirement of P was considered 16 mg P/kg BW, very close to the endogenous fecal losses in cattle fed phosphorus concentrations at or near requirements (NRC, 1996). Phosphorus also functions in cell growth and differentiation as a component of DNA and RNA; energy use and transfer as a component of ATP, ADP and AMP; phospholipid formation and maintenance of acid-base and osmotic balance. Phosphorus is required by rumen microorganisms for their growth and cellular metabolism. The process of demineralization of Ca in adult animals leads to the development of osteomalacia, weak and fragile bones and the P of the rickets.

The main symptoms of the animals observed during the twelve month period were: Micro: At least 17 minerals are required for cattle. These are linked to functions, signs of deficiency factors affecting the application, sources and toxicity of each essential element. Macro: Ca, P, Mg, K, Na and Cl and S. Microminerals: chromium, cobalt, copper, iodine, copper, iron, manganese, molybdenum, nickel, selenium and zinc. Other: arsenic, boron, lead, silicon and vanadium have been shown to be essential for one or more animal species, but there is evidence that these minerals are practically important in beef cattle.

Considering the requirements of the macro in the growth of the various animal categories (Table 7; NRC, 1996) the availability of 0.5-1.0% DM/animal/day does not provide the demands of protein, energy and mineral. Table 1-4 showed that the voluntary grazing animals are unable to meet the requirements of Ca and P.

Considering the requirements of the macrominerals animals in maintenance, growth and termination, pregnancy and lactation, the mineral content in the present study (Table 1-4), based on intake of 0.50-1.00% of BW as forage available *B. decumbens* not

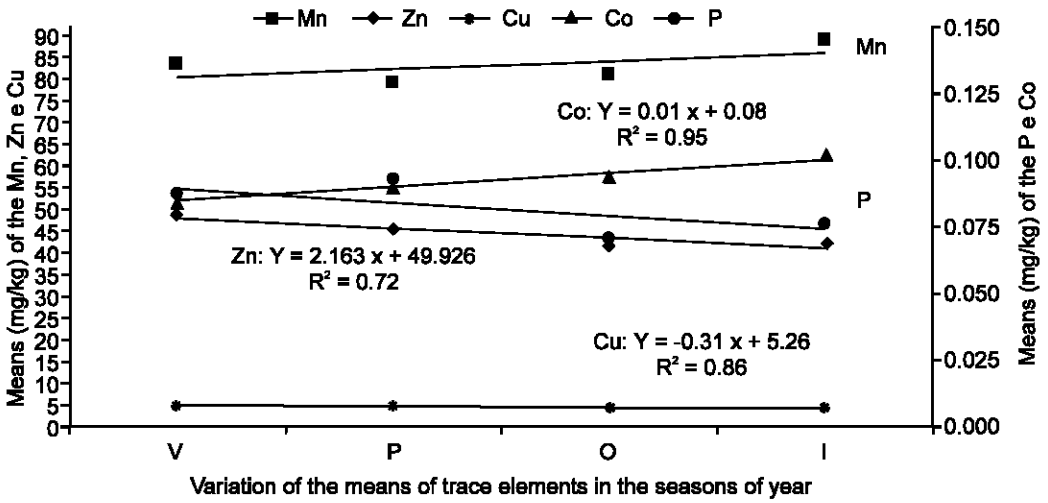

Fig. 1: Variation of the means of minerals Mn, Zn, Cu, P e Co in *B.decumbens* in the seasons of year

Table 7: Calcium and phosphorus requirements

	Requirements, g/day			
			Cows	
Mineral	Unit	Growing and finishing cattle	Gestating	Early lactation
	Maintenance (mg/kg body weight/day)	Growth (gain 100 g protein)	Pregnancy (last 90 d) (g Ca/kg fetus weight)	Lactation (g/kg)
Ca[1]	15.4	7.1	13.7	1.23
P[2]	16	3.9	7.6	0.95

[1]50% absorption. Requirement variable second dry matter digestibility: 0.25%, 0.40-1.11%. Ca: P- 1:1-7:1. 80% P in bone and tooth. [2]64% absorption in the forage and 70% concentrates. Fonte: NRC (1996)

Table 8: Requirement mineral and concentration maximum tolerable

		Requirements			
			Cows		Maximum
Mineral	Unit	Growing/ Finishing	Gestation	Early Lactation	Tolerable Level
Mg	%	0.10	0.12	0.20	0.40
Co	mg/kg	0.10	0.10	0.10	10
Cu	mg/kg	10	10	10	100
Zn	mg/kg	30	30	30	500
Mn	mg/kg	20	40	40	1000
Fe	mg/kg	50	50	50	1000

Fonte: NRC (1996)

meet the requirements of Ca and P of the different categories of animals. Similar observations were made by (Prada *et al*., 1983; Sousa *et al*., 1979; Moraes *et al*., 1999 and Tokarnia *et al*., 1999) when reviewed over a period of twelve years, the main mineral deficiencies in cattle in relation to the mineral composition of forage available to grazing in central Brazil.

Considering the requirements of trace minerals in animal maintenance, growth and termination, pregnancy and lactation (NRC, 1996), the concentration of trace elements highlighted in this research in Table 1-4, based on intake of 0.5-1,00% of BW as forage *B. decumbens* in the seasons do not meet or showed marginal deficiencies in relation to the requirements of Co, Cu, Zn and Mn of the different categories of animals (Table 8; Fig. 1). Tokarnia *et al*. (1971, 1988), Lopes *et al*. (1980), Sousa *et al*. (1982), Sousa and Darsie (1985) and Moraes *et al*. (1999) in survey stations and water and dry in the states of Mato Grosso found average levels of trace minerals below the requirements of grazing forage. Mortality of large numbers of animals in flocks of broilers reared extensively in the dry season by multiple mineral deficiency has been diagnosed in several Brazilian states (Fernandes and Camargo, 1976).

Important aspect is mentioned by Underwood (1981) and McDowell (1992) on the application of Cu which can range from 4 ppm to greater than 15 ppm depending on

the magnitude of the concentration of Mo and S in the diet and breed of the animal. The recommended concentration of Cu in the diet of beef cattle is 10 ppm. This amount will be adequate in Cu when the diet does not exceed 0.25% S and 2 ppm Mo. The antagonistic action of Mo on Cu is exacerbated when the S is also high. Insoluble complexes with Cu in the rumen tiomolibidato affect the absorption of Cu. In pastures containing 3-20 ppm of Mo supplementation 7-14 mg Cu/kg DM was insufficient According to the author above. In the region studied in this research, the supply requirements of beef cattle older adults estimated at 450 kg BW would be compromised or prejudice when the only source of major nutrients required in the form of metabolizable energy, digestible protein, vitamins and minerals is absorbable pasture. The low quantity and quality of MS available grazing livestock are the main causes of low output rate on the farm and is responsible for the appearance of many diseases linked to malnutrition, energy, vitamins and minerals (Underwood, 1983).

For the deficiencies of minerals can be inferred that the herds in this study listed the following signs and symptoms: swollen face, rickets, previously existing, infertility, excitability, loss of appetite, anemia, stunted growth, depigmentation (acromotriquia) and physical appearance of the hair, heart failure, fragile bones and fracture expontanea, diarrhea, infertility and anestrus, low fertility, abortion, stillbirth and low birth weight, lesions of the parakeratosis and tetany pastures.

Conclusion: The deficiencies of macro and trace elements in cattle grazing in the region subjected to the nine counties studied supplemented shall at all times and in all seasons. The study revealed a worsening of disability in the dry season of the year (autumn, winter and transition to spring) when the deficiencies highlighted by the low quality and quantity of dry matter and consequently of all nutrients and therefore imposing the need for supplementation of dry matter and correction of nutrient for the provision of adequate energy, protein, minerals and vitamins. The season of water shows significant need to correction the requirements of protein and minerals. This season should supplemented minerals to additional the needs for major intake of dry matter available in the pasture. Supplementation to correct the deficiencies of nutrients required in accordance with the category the grazing animal. Among the minerals studied, cattle and young adults need the supplemental source of P, Cu, Co and Zn. Cattle production in need of supplementation of all macro and micro studied therefore the need to correct the deficiency of pasture and supplement intake of dry matter. Complete mineral mix should be available to animals in times of the year and especially in the dry season.

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