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Levels of lead in mineral salt commercial mixtures for beef cattle

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Lead concentrations was measured in samples of mineral mixtures used in beef cattle feed in the states of São Paulo, Paraná, Mato Grosso and Mato Grosso do Sul, Brazil. Lead content was determined by inductively coupled plasma atomic emission spectrometry. Of the 60 analyzed samples, 21 had values greater than 30 ppm (range less 1.6 to 460 ppm), which is the maximum concentration recommended [3,14]. These findings show the necessity for careful industrial monitoring because some mineral mixtures contain sufficient lead to cause toxicity in animals.

Key words: lead, beef cattle, mineral salt

Introduction

The increasing commercialization of mineral salt mixtures for animal ingestion in Brazil is the main reason why the mixture industry has to reduce costs, with the aim of winning a market and thereby guaranteeing its future business. Even with the concept of total quality, some aspects have been relegated to second place, such as the sources of raw materials that comprise mineral salt mixtures, in order that they are chosen at the most accessible price, exclusive of imports.

This facet has become a concern among nutritionists, clinical veterinarians and technicians oriented towards health and animal production, because it is believed that some new mineral formulations can be contaminated by toxic elements, above all by heavy metals and radioactive substances. For that reason, an investigation research project was launched to evaluate the level of pollutants in mineral formulations used in Brazilian cattle feed supplement. Based on certain information received from the National Agriculture Department there are currently approximately 5,500 different mineral mixtures being sold throughout the Brazilian national market [11].

Accordingly, the aim of the present research is to investigate the xenobiotic presence in some different mineral supplements produced in Brazil, employing laboratory analysis to quantify those pollutants that can be connected with the macro and micro mineral elements of the formulations prepared for animal feed.

The element chosen for investigative study was lead, considered by many specialists to be an inorganic element of greater risk to animal husbandry, particularly in the bovine species [3,13,14,20], being possible its transmission to animals through the ingestion of contaminated mineral formulations.

Material and Methods

Small portions of the same form of mineral salt were collected at each of the selected rural properties, forming a "pool" of a representative sample, amounting to approximately 200 grams of the stock of mineral salt maintained at the farm. The samples were conditioned in transparent plastic containers, previously identified and which were then analyzed at the National Commission of Nuclear Energy (CNEN) Laboratory of Poços de Caldas, Minas Gerais, Brazil.

The analytic methodology used for lead determination in the mineral salt was that the samples were dried previously to 110ºC for approximately two hours. The solubilization made by nitric acid was that the lead was separated from the sample for extraction with pyrrolidine ammonia ditiocarbonate (APDC) *p. a.* in pH 2.3 ± 0.1.

Determination was executed by spectrometry of atomic emission by induction plasma coupled in 220.3 nm, using a JARREL-ASH, model 975 spectrometer [2,7]. Limit of determination of the method is 1.5 ppm.

To calculate the values of central tendency (average and medium), percentage for the quantitative variables and

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Table 1. Lead concentrations in individual samples of mineral salt in Brazil

State	Sample	City	Value of lead (ppm)
Mato Grosso	1	Paranatinga	5.8
	2	Tangará da Serra	42.2
	3	Tangará da Serra	55.8
	4	Juína	2.5
	5	Cuiabá	5.4
	6	Rondonópolis	1.6
	7	Rondonópolis	1.8
	8	Rondonópolis	2.7
	9	Rondonópolis	2.8
	10	Acorizal	2.9
	11	Alta Floresta	38.0
	12	Barra do Garças	5.6
	13	Sorriso	15.0
	14	Sorriso	2.8
	15	Juara	77.0
Mato Grosso do Sul	16	Rio Verde de Mato Grosso	53.0
	17	Aparecida do Taboado	127.1
	18	Brasilândia	4.0
	19	Nova Alvorada do sul	3.7
	20	Três Lagoas	11.3
	21	Maracaju	43.8
	22	Paranaíba	4.7
	23	Paranaíba	460.0
	24	Campo Grande	64.0
	25	Dourados	77.0
	26	Caarapó	31.0
	27	Inocência	37.2
	28	Dourados	3.9
	29	Paranaíba	1.7
	30	Paranaíba	3.7
São Paulo	31	Castilho	5.6
	32	Martinópolis	28.2
	33	Martinópolis	284.5
	34	Martinópolis	19.1
	35	Taciba	43.8
	36	Presidente Bernardes	5.0
	37	Avaré	3.8
	38	Avaré	15.4
	39	Avaré	35.7
	40	Avaré	3.4
	41	Mogi Mirim	50.8
	42	Ribeirão Preto	3.0
	43	Araçatuba	4.3
	44	Bauru	9.9
	45	Presidente Bernardes	3.1
Paraná	46	Londrina	7.4
	47	Londrina	2.7
	48	Rolândia	3.1
	49	Cornélio Procópio	4.9
	50	Cambé	11.3
	51	Maringá	133.0
	52	Maringá	4.9
	53	Castro	5.4
	54	Maringá	100.0
	55	Umuarama	56.0
	56	Maringá	3.3
	57	Cascavel	208.0
	58	Paranaguá	47.2
	59	Toledo	30.0
	60	Londrina	6.3

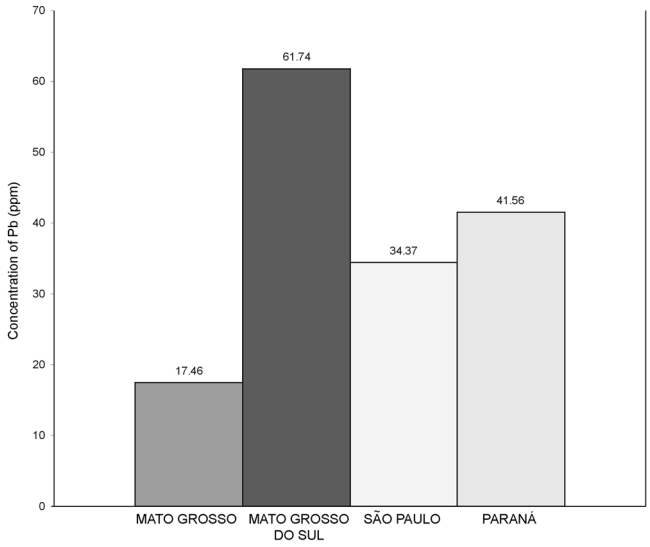

Fig. 1. Average values (N=60) for lead concentrations in mineral salt from four states in Brazil correlated with reference values from [3,14].

variability values (deviate pattern and variation coefficient), the program SAS/BASIC was used [16].

Results

The results obtained from the present research, whose inorganic lead element was quantified in 60 mineral formulations produced in the four states, are presented in Table 1, and Fig. 1.

Discussion

Concern about mineral formulations contaminated by metallic elements and/or radioactive substances has been a preoccupation for technicians and farmers, generating debates among researchers in several countries around the world, gaining more followers in the early nineties.

The subject of sanitary control in animal feeding has been developing greatly in Brazil also, and it seems to be increasingly strengthened by specialistís participation in practical objectives.

In that respect, the main proposal in this study is to investigate the lead element presence in mineral, mixed supplements produced in Brazil. Up until now, there has been no research of this kind anywhere in the country.

Taking into account the high number of mineral formulations on the market in this country, we proceeded to select samples in only some of the manufacturing states. One approach is working in some federation states holding a significant number of bovines in its effective animal population. The states chosen were Mato Grosso, Mato Grosso do Sul, São Paulo and Paraná which together hold approximately 44% of the bovine herds in Brazil [8].

Based on this important aspect, the ease of contact with our collaborators in those selected states provided us with the necessary confidence to commence and conclude the tasks, since the previous rise in both states demonstrated that there were more than fifteen different marks in each mineral mixture.

In several samples, the values extrapolate the acceptable maximum limit of 30 ppm [3,14], being the largest value found, 460 ppm, refers to a mineral formulation sold in the state of Mato Grosso do Sul, which has the largest bovine herd in Brazil.

In the analytic detection of lead in the mineral formulations, it was not possible to separate the raw material components, so in order to proceed with the investigation the authors worked with readily industrialized formulations.

The greater suspicion is that lead presence in the mineral mixture is traceable to phosphorus sources, where these represent the highest cost in the mineral salt composition [15,17], thereby inducing industries to find it in cheaper, alternatives sources.

The connotation of lead being connected with sources of phosphate can be exemplified by the natural rock, phosphates [1,5,15,19] or with foreign phosphoric acid [4, 11]. It is extremely important to remember that xenobiotics can originate from raw materials of microelements [5,6].

It is necessary to emphasize that the purpose of the next stage in this work will be to investigate the sub-clinical aspects in bovines which have consumed mineral salt with toxicant considered levels, since bovine saturnism toxicity clinical symptoms are known classically, and this hypothesis indicates that such research would be of no interest. The main aim is to verify changes in the bovine reproductive system, investigating possible interferences in the reproductive cycles of cows and changes in performance [9,10,13,18].

This seems to be an opportune and important moment for such a cause, as today, at the beginning of the third millennium, Brazil has one of the largest commercial bovine herds anywhere in the world [11,12]. The country is still developing its conquests of new horizons, attempting to increase its bovine population of 154, 440, 803 [8,11], and keen to expand its business with partners in the South American Economic Community.

Analysis of results observed in researches conducted to date permits the following conclusions:

1st) twenty-one samples were found with a lead concentration above 30 ppm [3,14], representing 35% of the analyzed mineral formulations;

2nd) the best average results refers to mineral formulations sold in Mato Grosso state;

3rd) the largest value found, 460 ppm, refers to a mineral formulation sold in the state of Mato Grosso do Sul, which has the largest bovine herd in Brazil.

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