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INORGANIC LEAD CONCENTRATION IN MINERAL SALT COMMERCIAL MIXTURES FOR BEEF CATTLE IN SÃO PAULO STATE, BRAZIL

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ABSTRACT

The lead concentration in mineral mixtures used in beef cattle in the state of São Paulo, Brazil was measured. The lead concentration was determined by inductively coupled plasma atomic emission spectrometry. Of the 39 analyzed samples (range 3.0 to 4,386 ppm), 28 samples had lead concentration above 10 ppm the acceptable maximum limit proposed by MALETTO (1986). These findings show the necessity for careful industrial monitoring, as some mineral mixtures contain sufficient lead to cause toxicity in animals.

KEY WORDS: Lead, beef cattle, mineral salt, xenobiotic.

RESUMO

CONCENTRAÇÃO DE CHUMBO INORGÂNICO EM MISTURAS MINERAIS PARA BOVINOS DE CORTE COMERCIALIZDAS NO ESTADO DE SÃO PAULO. Para se proceder a uma investigação em misturas minerais, foi realizada uma pesquisa quantificando o elemento chumbo em diferentes formulações, comercializadas no Estado de São Paulo. O xenobiótico foi determinado pela técnica de espectrofotometria na absorção atômica. Em 28 das 39 amostras (variação de 3,0 a 4.386 ppm) observou-se valores superiores aos 10 ppm recomendado como limite máximo aceitável por MALETTO (1986). Os resultados demonstram a necessidade do monitoramento junto aos fabricantes, pois algumas misturas minerais podem ser eminentemente perigosas, possibilitando efeitos cumulativos tóxicos de chumbo inorgânico aos bovinos.

PALAVRAS-CHAVE: Chumbo, bovinos de corte, sal mineral, xenobióticos.

INTRODUCTION

In Brazil, the state of São Paulo has an important technology in cattle raising with extesive marketing of mineral supplements.

Nevertheless, the increasing price of raw materials is the main reason that mineral mixture industries are looking to reduce costs with the aim of winning markets and guaranteeing business. Because of this, research into the quality of the raw material sources is being done.

In this respect, it is believed that some new mineral formulations can be contaminated by toxic elements, such as heavy metals and radioactive substances. Cheap raw material sources are the most likely origin of this problem. For this reason, a study aimed at evaluating the level of pollutants in the mineral formulations used in Brazilian cattle, which today number approximately 5,500, was initiated.

The main goal of this study was to investigate the xenobiotic presence in various mineral supplements produced in Brazil. This was accomplished by analysis of the pollutants that may be attached to the macro and micro mineral elements present in the mineral formulations in animal feed.

Lead was chosen for this study, as it is considered by many specialists to be an important xenobiotic (NATIONAL RESEARCH COUNCIL, 1980; ASSOCIATION OF AMERICAN FEED CONTROL OFFICIALS INCORPORATED, 2001; MARÇAL et al., 2003). Lead is highly toxic, and can be introduced to cattle via the ingestion of contaminated mineral formulations (NATIONAL RESEARCH COUNCIL,

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1980; MALETTO, 1986; MARÇAL *et al.*, 2001; MARÇAL *et al.*, 2003).

MATERIAL AND METHODS

Pooled samples (approximately 200 g) of mineral mixtures were collected from each of the city selected in São Paulo State. The samples identified were placed in sealed plastic bags and analyzed by the National Commission of Nuclear Energy (CNEN), Laboratory at Poços de Caldas, Minas Gerais, Brazil. The samples were dried at 110° C for 2h, dissolved in nitric acid and then the lead was extracted using ammonium pyrrolidine dithiocarbonate (APCD) p.a. at pH 2.3 ± 0.1. The lead concentration was determined by inductively coupled plasma atomic emission, at 220.3 nm, using a Varian model 220 FS spectrometer.

The analysis methodology was based on the AMERICAN SOCIETY FOR TESTING AND MATERIALS (1980) and EATON et al. (1995). The detection limit of this method was 1.5 ppm Pb. Statistical analyses were made using the SAS / BASIC program.

RESULTS

The lead concentrations in the 39 different mineral mixture samples commercialized in different cities of São Paulo State, are shown in Table 1.

Table 1 - Average values of lead concentrations in individual samples of mineral salt from São Paulo State, Brazil, 2005.

Sample	Commercialized City	Lead concentrations (ppm)
1	Araçatuba	4.3 ± 0.4
2	Avaré	3.8 ± 0.4
3	Avaré	15.4 ± 1.3
4	Avaré	35.7 ± 2.8
5	Avaré	3.4 ± 0.3
6	Batatais	20.2 ± 1.0
7	Bauru	9.9 ± 0.8
8	Birigui	13.7 ± 0.7
9	Birigui	18.2 ± 0.9
10	Campinas	146.0 ± 7.0
11	Castilho	5.6 ± 0.4
12	Fernandópolis	16.0 ± 0.8
13	General Salgado	26.2 ± 1.3
14	Guarantã	94.0 ± 4.5
15	Martinópolis	28.2 ± 1.4
16	Martinópolis	19.1 ± 0.9
17	Mogi Mirim	50.8 ± 2.5
18	Piracicaba	28.7 ± 1.4
Continuation		
19	Presidente Bernardes	5.0 ± 0.4
20	Presidente Bernardes	3.1 ± 0.2
21	Presidente Prudente	27.6 ± 1.3
22	Presidente Prudente	8.0 ± 0.9
23	Presidente Prudente	11.9 ± 1.0
24	Presidente Prudente	23.0 ± 1.2
25	Presidente Prudente	40.6 ± 2.0
26	Presidente Prudente	14.0 ± 0.7
27	Presidente Prudente	111.0 ± 5.2
28	Presidente Prudente	15.8 ± 1.2
29	Presidente Prudente	5.96 ± 0.4
30	Presidente Prudente	4,386.0 ± 210
31	Presidente Prudente	87.6 ± 4.2
32	Presidente Prudente	28.1 ± 1.1
33	Presidente Prudente	31.6 ± 1.5
34	Presidente Prudente	27.9 ± 1.4
35	Presidente Prudente	7.07 ± 0.8
36	Ribeirão Preto	3.0 ± 0.3
37	Santo Anastácio	156.0 ± 7.6
38	São Paulo	34.1 ± 1.7
39	Taciba	43.8 ± 2.2

DISCUSSION

In Brazil, the sanitary and nutritional control of animal feed has come under increasing attention in recent years. Up to now, however, there has been little relevant research. Our studies of lead content in mineral mixes represent a beginning of attempts to remedy the situation caused by a lack of specific research.

Some 5,500 different trademarks of mineral mix are sold in many cities of Brazil. We therefore chose to sample from those used in São Paulo State, where there are 1,376 different brands (MARÇAL et al., 2003). One approach is working in a state holding a significant number of bovines in its effective animal population. São Paulo State has 14,046,426 cattle, the majority being beef cattle (IBGE, 2003).

Our results demonstrate that 28 of the 39 samples of São Paulo exceeded the acceptable maximum limit for lead (10 ppm) proposed by MALETTO (1986). However, only 12 samples exceeded the maximum value of 30 ppm proposed by the NATIONAL RESEARCH COUNCIL (1980). Currently, with the aid of modern technology, it is expected that the National Research Council, should revise these reference values so that lower fluctuation values can be found. Moreover, it is recommended that a zero lead concentration should be present in any analyzed sample. For that reason we have accepted the limits proposed by MALETTO (1986), since the minimum of contamination with heavy metals, like inorganic lead, should exist in mineral supplements. That would avoid risks for consumers of meat, and many problems of public health.

It is most probable that lead in the mineral mixes comes mainly from sources of phosphorus since phosphorus represents the largest cost factor in the mineral salt composition (SOUSA, 1981; ROSA, 1989) and manufactures seek cheaper alternatives. Evidence of the presence of lead in phosphates has been provided for natural rock phosphates (VIANA, 1985; ROSA, 1989; CAMPOS NETO & MARÇAL, 1996). However, we cannot discard that the lead can be present in the microelements (CAMPOS NETO & MARÇAL, 1996; MARÇAL et al., 2003).

The next phase of our studies will be to investigate possible subclinical effects of lead toxicity in cattle receiving mineral mixes with the highest lead content. Possible interferences with reproductive cycles of cows and decreased levels of performance will be the main effects consideres(STUART & OEHME, 1982; MCDOWELL, 1985; MARACEK et al., 1998; MARÇAL et al., 2003). Moreover, the animals that consume great amounts of inorganic lead in the mineral salt could be defecating those elements in the environment, could take the contaminations from the soil, plants and of the sources of drinking water. It is also important to note that excessive amounts of lead in the diet are known to depress food consumption and may induce calcium deficiency (BARTON et al., 1978; MARÇAL et al., 2001).

If manufacturer of mineral salt mixes do not monitor the purity of their formulations rigorously, there is increasing probability of toxic contamination. The possibility exits that this could also pose a threat to human consumers of beef and this would have a negative effect on Brazil's global competitiveness.

CONCLUSIONS

Analysis of our results leads to the following conclusions:

1) among the 39 analyzed formulations of São Paulo Sate, 28 samples (71.7%) presented results above the 10 ppm of lead threshold proposed by MALETTO(1986);
2) the largest value found, 4,386.0 ± 210 refers to a mineral formulation sold in Presidente Prudente city, which has the large bovine herd in Brazil;
3) greater care in industrial monitoring is necessary because some mineral mixtures contain sufficient lead to cause toxicity.

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