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Quantitative Determination of Nitrates in Oats

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Abstract: There are very few cases of poisoning in bovines associated to high levels of nitrates in grazing fields in Uruguay and the lack of information is very notorious. For this essay, determined levels of nitrates were studied in eight samples of oats during the winter in three different areas of the country. The aim was firstly to investigate if any of the samples showed toxic levels, secondly, to compare them and thirdly, to study if there is any significant difference between them. The quantification of nitrates was done by the method of reduction of hydrazine sulphate. As known, the amounts of nitrates in grazing fields change according to the vegetative cycle. An investigation was carried out to study if there were variations in the levels of nitrates in oats in each season in the area of San José. All the results obtained indicate the innocuousness of oats in samples studied. The values were significantly less during the spring.

Key words: Nitritepoisoning, veterinary toxicology, nitrate levels, Oat

INTRODUCTION

Intoxication with nitrates and nitrites in Uruguay caused serious problems in the decade of 1980 and in the last years there have been sporadic cases of bovine mortality that gazed oats (*Avena sativa, Avena byzantina*), although the majority of this cases were never documented. These clinical cases were presented in autumn and winter. Intoxication with nitrates and nitrites are well described in the classical textbooks[1-3].

There are various analytical procedures that allow the identification of the levels of nitrates accumulated in plants which could be used as preventive to establish the handling of oat pasture. An essay, practical and well-known experiment is the use of the reactive diphenylamine blue, but this is a qualitative experiment. The development of an intense blue colour in 10 sec indicates a concentration of nitrates superior to 1%. The result of this experiment can be inaccurate. There are commercial analysis of rective strips for this use in the country[3]. For the present task the technique of Sthar[4] was used, in order to carry out the quantifications. Other laboratory techniques have been described, as well[5]. Nitrates accumulate mainly in the base of the stem and leaves of young plants. The dark green colour and vigorous aspect is common in plants with high levels of nitrates.

According to the bibliography, plants 1.5 % or more nitrates, expressed as potassium nitrate in a dry base produce acute poisoning[1-3]. Determinations of nitrates in oats were carried out during 2002 in three different areas of the country and in 24 establishments. The selected areas were San José, Paysandú and Canelones. The aim is to generate information related to the levels of nitrates in oats, investigate if any sample reached the threshold of toxicity, compare the levels of nitrates in oats in three areas of the country and see if these vary in the different seasons. Let's keep in mind that autumn begins in March and winter in July in the Southern Hemisphere.

The samples used came from oats which had previously had nitrogenous fertilization. Eight samples of oat mixtures were monitored in each area. These samples were made up of equal amounts of stems levels. The quantification of nitrates was carried out using the technique described by Sthar in his manual Analytical methods in Toxicology 1991. The method of reduction of hydrazine sulphate was carried out[4]. A three – monthly visit was made to San José to carry out a seasonal evaluation. Meteorological data was proportioned by the National Meteorology Office.

The values of the determinations shown in Table 1. There were average rainfalls during the experimental period and no hydric shortage. Three determinations of the levels of nitrates in oats were carried out during the winter in San José, Paysandú and Canelones and the concentrations of nitrates in oats were significantly higher

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Table 1: Concentrations of nitrates obtained in San José (SJ) Paysandú (PDU) and Canelones (CAN).

MUESTRA	CONC. (ppm NO_3 in dry base)
2 SJ june	450
3 SJ june	933
4 SJ june	3.000
6 SJ june	900
7 SJ june	1.625
9 SJ june	800
11 SJ june	1.789
13 SJ june	1.200
2 SJ july	2.500
3 SJ july	1.143
4 SJ july	1.067
6 SJ july	1.250
7 SJ july	824
9 SJ july	1.133
11 SJ july	1.875
13 SJ july	1.733
2 SJ oct	222
3 SJ oct	1.056
4 SJ Oct	917
6 SJ oct	893
7 SJ oct	529
9 SJ oct	190
11 SJ oct	1.750
13 SJ oct	708
1 PDU aug	1.105
2 PDU aug	696
3 PDU aug	1.000
4 PDU aug	6.429
5 PDU aug	439
6 PDU aug	864
7 PDU aug	727
8 PDU aug	850
1 PDU nov	800
2 PDU nov	500
3 PDU nov	737
4 PDU nov	2.811
5 PDU nov	957
6 PDU nov	556
7 PDU nov	230
8 PDU nov	455
1 CAN set	1.250
2 CAN set	833
3 CAN set	824
4 CAN set	882
5 CAN set	700
6 CAN set	714
7 CAN set	714
8 CAN set	1.100

in San José. In the winter there were no significant differences between the concentration of nitrates in oats in Paysandú and Canelones. The average nitrates in oats in winter were the following. (ppm in dry substance):

San José - 1197
Paysandú - 857
Canelones - 829

In the spring there are two groups of determinations: San José and Paysandú.

The average nitrates in the spring were:

San José 800
Paysandú 647

We conclude that in one of the studied samples, toxicity reached potential levels (San José, April, 3000 ppm in dry substance of the oat). In spite of this, the level does not imply acute risk of poisoning. Comparing the different areas during the same season (winter) a significant difference between the values of San José and Canelones were found, but no significant difference was found between Canelones and Paysandú. San José was significantly superior to Paysandú and Canelones .With regard to the seasonal variation of these values in grazing lands of San José, the values were significantly lower during the spring. This coincides with the bibliography[1-3] that mentions that the content of nitrates decrease as the plant ripens. We also conclude that there is no significant difference between the concentrations of nitrates in oats in the spring in the samples of San José and Paysandú . In none of the areas (San José, Paysandú and Canelones) could we correlate the levels of nitrates in oats with the levels of nitrates in the soil because samples of the soil were not processed. All the processed samples had received nitrogenous fertilizations prior to sowing of incidence of these in the final concentration reached in the samples could be not be carried out. A comparison of the samples of non fertilized oats could not be carried out, nor was the level of fertilization employed known, we were only aware that it was done according to agronomic criteria. Drought is considered the most important cause in Uruguay. As proved in the pluviometric facts in the meteorological report, There was no hydric shortage prior to any sample taking which coincides with the low levels reached in the determinations. This technique is considered to be very exact when Quantifying nitrates but it requires a lot of time, a well equipped laboratory and a spectrophotometer in perfect working conditions. The veterinary in the country must carry out the experiment of diphenylamine blue (for plants and sanguineous serum) or use reactive strips. In spite of this, in the pasture season of pastures like oat, there must always be methylene blue available. This is an antidote reducer of methemoglobin.

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