EVALUATION OF COPPER CONCENTRATION IN SOME DAIRY COW FEEDING RAW MATERIALS

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Abstract

Copper is a metal that occurs naturally the environment and an essential nutrient for plant growth and development; ingested in food by high concentrations, copper is potentially toxic to both humans and animals.

The aim of this study was to evaluate copper concentration in some raw materials used in feeding dairy cows during 2006-2007 period.

Fifty-five samples of grass, vetch, alfalfa, Sudan grass, alfalfa hay, grass hay, corn silage, maize, wheat bran, sunflower meal and brewery dregs were analyzed to evaluate copper concentration in feeds. Copper concentration was assesed using atomic absorbtion spectrofotometry method in flame.

Results (expressed in mg/kg related to dry matter) shown that all analyzed samples contained copper residues in detectable amounts.

For samples harvested in 2006 year, the average concentration of copper ranged from 1.27 mg/kg D.M. in sunflower meal at 3.70 mg/kg D.M. in wheat bran, while samples of feed from 2007 year, values were between 0.30 mg/kg D.M. in brewery dregs and 3.89 mg/kg D.M. in alfalfa.

Values obtained in this research as regards the contents of copper were lower compared with results of other researches conducted and data from literature.

Key words: minerals, copper, raw materials, dairy cows

INTRODUCTION

Some trace elements are essential nutrients for plant growth and often also for food and feed quality because the primary route for their intake by humans and animals is plants. Because these elements are considered essential to life, they could be called "bioessential."

Trace mineral concentrations are affected by four interdependent factors: 1) the genus, species or variety of crop, 2) type and mineral concentration of the soil, 3) stage of plant maturity, and 4) climatic or seasonal conditions [2]. Copper is a reddish metal that occurs naturally in rock, soil, water, sediment and low levels in the air.

Copper is an essential element for normal growth and development of plants, nevertheless, excess or deficiency, can cause disorders in plant growth and development by a negative impact on important physiological processes [4]. In plant material, copper concentration ranges from 1 ppm to 50 ppm, dry basis [12]. Affinity of plants for metals is different from a species to another [6]. Copper is not easily absorbed into plants, thus the concentration in roots is higher than the concentration in other parts of plants. In general, legumes contain greater quantities in microminerals and macrominerals than grasses [2].

The aim of this study was to evaluate copper concentration in some dairy cow feeding raw materials during 2006-2007 period.

MATERIAL AND METHOD

Various samples of raw materials used in dairy cow feeding were analyzed during two years 2006 and 2007. Samples of grass, vetch, alfalfa, Sudan grass, alfalfa hay, grass hay, corn silage, maize, wheat bran, sunflower meal and brewery dregs were analyzed to

evaluate copper concentration in raw materials.

Copper concentration was assesed using atomic absorbtion spectrofotometry method in flame.

The harvesting and the preparation of raw materials samples for analysis were made according to the legal standard SR ISO 6498:1999 and to the sanitary- veterinary norms.

The quantitative determination of copper in raw materials samples was made using an absorption spectrophotometry method with a flame burner fed with an air-acetylene mixture up to 2250°C in a GBC-AVANTA FAA analyser.

The calibration curve of absorbance against concentration was obtained, used standard solutions (Merck), in three points: 1, 2, 4 ppm. The wave-lenght used for detremination of copper was 324.7 nm. The results of copper concentration are shown in mg/kg (ppm) dry matter.

RESULTS AND DISCUSSIONS

Average concentrations of copper in samples of raw materials analyzed are presented in tab. 1 and 2, while in fig.1 are represented graphically, compared for the two years (2006-2007), average values recorded in those samples.

Table 1
Average concentration of copper in raw materials, mg/kg D.M., 2006

Raw materials		No. sample	$\bar{X} \pm s_{\bar{x}}$	s	v%
Maize		5	2.21±0.03	0.06	2.56
Wheat bran		5	3.70±0.04	0.10	2.60
Sunflower meal		5	1.27±0.05	0.10	8.03
Brewery dregs		5	2.17±0.07	0.16	7.44
Alfalfa hay		5	3.16±0.07	0.15	4.75
Grass hay		5	1.84±0.07	0.17	9.12
Corn silage		5	3.33±0.06	0.13	3.90
Vetch		5	2.02±0.05	0.12	5.84
Alfalfa		5	3.16±0.08	0.17	5.32
Sudan grass		5	2.40±0.06	0.14	5.92
Grass		5	2.25±0.07	0.16	6.91
TOTAL	Average	55	2.47±0.06		
	Min.-Max.		1.27-3.70	0.06-0.17	2.56-9.12

Table 2
Average concentration of copper in raw materials, mg/kg D.M., 2007

Raw materials		No. sample	$\bar{X} \pm s_{\bar{x}}$	s	v%
Maize		5	1.10±0.01	0.03	2.61
Wheat bran		5	3.39±0.01	0.03	0.82
Sunflower meal		5	2.26±0.01	0.02	0.73
Brewery dregs		5	0.30±0.01	0.02	7.62
Alfalfa hay		5	2.61±0.01	0.02	0.81
Grass hay		5	1.86±0.01	0.01	0.73
Corn silage		5	1.85±0.01	0.02	1.22
Vetch		5	2.03±0.01	0.03	1.31
Alfalfa		5	3.89±0.02	0.05	1.16
Sudan grass		5	1.76±0.01	0.02	1.15
Grass		5	2.28±0.02	0.04	1.64
TOTAL	Average	55	2.13±0.01		
	Min.-Max.		0.30-3.89	0.01-0.05	0.73-7.62

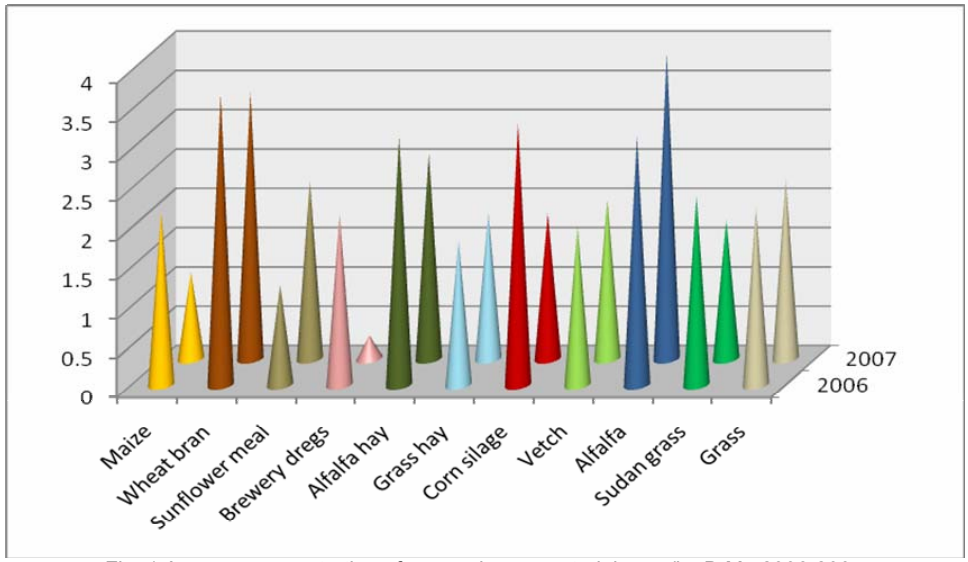

Fig. 1 Average concentration of copper in raw materials, mg/kg D.M., 2006-2007

The results shown that all analyzed samples contained copper in detectable amounts. In 2006 year, the mean values of copper concentration ranged from 1.27 mg/kg D.M. in sunflower meal to 3.70 mg/kg D.M. in wheat bran and from 0.30 mg/kg D.M. in brewery dregs to 3.89 mg/kg D.M. in alfalfa, during 2007 year.

Average copper concentrations in alfalfa (3.16 mg/kg D.M. in 2006 year and 3.89 mg/kg D.M. in 2007 year) are higher than average concentrations in Sudan grass (2.40 mg/kg D.M. in 2006 year and 1.76 mg/kg D.M. in 2007 year) or grass (2.25 mg/kg D.M. in 2006 year and 2.28 mg/kg D.M. in 2007 year).

Compared to other investigations made in different countries, in some feed materials, the copper concentration levels found were higher:

- in Ireland, the values obtained on the concentration of copper in different feed analyzed were: 5.115 mg/kg D.M. in maize silage, in grass 9.217 mg/kg D.M., and 5.843 mg/kg D.M. in hay [9];
- the average concentration of copper obtained from the Montana-USA grass, grass+legumes and legumes hay samples collected over the past two years were: 5.2 mg/kg D.M. in grasses, 7.0 mg/kg D.M. in grass+legumes and 8.8 mg/kg D.M. in legumes hay [8];
- in India, the copper content in maize samples collected from the feed processing unit, ranged to7.7 mg/kg D.M. from 18.2 mg/kg D.M. [10];
- in Nigeria, was analyzed different cereals for the determination of copper content; values ranged from 7.1 ppm to 11.0 ppm in white maize and from 6.2 mg/kg D.M. to 9.4 mg/kg D.M. in yellow maize [5].

Different values obtained as regards the concentration of copper in the feed may be assigned different types and compositions of the soil and the presence / absence of specific factors pollutants.

The copper content of the most common forage sources indicated some specialized institutions in various countries is presented, as an indication, in tab. 3 [7].

The addition of trace minerals and certain vitamins to in ration of dairy cows was considered a good nutritional insurance.

Trace minerals are needed by the dairy animals in very small quantities (parts per million); for this reason, salt is commonly used as a carrier for all the trace minerals [1].

Mineral nutrition of animals is extremely complicated. Many interactions can occur between trace elements or trace elements and other nutrients. These interactions can be very complex. Deficiency or toxicity of Cu are caused by interrelations that he has with other mineral elements, depending on their concentration [11].

Table 3
Common levels of copper in some feed materials (mg/kg DM) [7]

Feed materials	Cu	Feed materials	Cu
Alfalfa hay	7.3	Straw Wheat	7
Barley	3.5-7	Grass hay	9.0
Rye	4-6	Sunflower	25
Sorghum	2.7-10	Maize	1.9-3.3
Straw Barley	1.7-5	Wheat bran	10-30
Maize silage	7.6	Oats	2.8-5

INRA= Institut National de la Recherche Agronomique (France),
DLG= Deutsche Landwirtschafts-Gesellschaft (Germany),
ACV= Afnemers Controle op Veevoeder (The Netherlands),
ADAS= Agricultural Development and Advisory Service (UK),
NRC = National Research Council (USA)

Research investigating the influence of copper in cattle nutrition in relation to health and performance, made evidence the influence of one or more antagonists such as molybdenum, sulfur, iron, and zinc, which can induce a copper deficiency in function and their concentration [12]. For example molybdenum concentrations below 1 ppm, have no effect on the requirement of copper, molybdenum, but if it is in a concentration above 3 ppm, it can have a strong antagonistic action on the absorption of copper [3].

Values obtained in this research as regards the contents of copper were lower compared with the results of other research conducted and the literature and indicate a low level of copper in feed analysis.

CONCLUSIONS

1. In 2006 year, the average concentration of copper in the feed analyzed ranged from 1.27 mg/kg D.M. in sunflower meal to 3.70 mg/kg D.M. in wheat bran.
2. In 2007 year, the average concentration of copper was between the limits of 0.30 mg/kg D.M. in brewery dregs and 3.89 mg/kg D.M. in alfalfa.
3. Low levels of copper obtained in this research justify to continuation monitoring of the presence of copper in feeds, indicating the uselfulness of using mineral supplements for performing animals.
4. The results obtained determine to do other investigations about the presence of copper in soil and feed and the levels of its antagonists.

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