Zinc, Copper and Cobalt Concentrations in Blood During Inflammation of the Mammary Gland in Dairy Cows

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ABSTRACT : A study was undertaken to record the utilization of some micro-elements during inflammation of the mammary gland. Two groups of twenty five animals each suffering from subclinical and clinical mastitis were selected for the study. All the animals were maintained on identical diets. Blood zinc level in cows with subclinical mastitis (5.66±0.52) was significantly ($p<0.05$) lower than that of healthy cows (8.46±1.10 ppm). No significant difference was, however, recorded in blood copper and cobalt levels between healthy and mastitic cows. (*Asian-Aust. J. Anim. Sci. 2001. Vol. 14, No. 4 : 564-566*)

Key Words : Cobalt, Copper, Dairy Cows, Inflammation, Mammary Gland, Zinc

INTRODUCTION

Deficiency of essential trace minerals plays a crucial role in precipitation of disease in man and animals (Inan et al., 1998, Nockels and Blair, 1996). Levels of many micro elements were reported to be altered during disease conditions (Banga et al., 1989) and supplementation with selenium was reported to be beneficial in preventing mastitis in cattle (Aseltine, 1991). In general, information on micro-mineral requirements in cows with subclinical and clinical mastitis is scanty. Studies in human subjects have shown that during infections some micro-nutrient deficiencies develop and dietary correction could not only prevent these disease conditions but also alleviate pathological lesion (Sorenson, 1987). Deficiencies of certain trace elements during subclinical and clinical mastitis have been reported (Lappalainen et al., 1988) but it remains obscure whether these are due to increased excretion or decreased absorption from feed and water. Further, complex interactions between these elements and increased body utilisation during inflammation of the mammary gland may also play a role in deficiency. Here, we report the blood Cu, Co and Zn status of cows having identical diets and milk production but suffering from subclinical and clinical forms of inflammation of mammary gland.

MATERIALS AND METHODS

Cross-bred (Jersey or Holstein Friesian × Indigenous breed) lactating cows between 2nd and 5th (4-7 years of age) lactation belonging to the dairy herd of Livestock Production Research Section of the Institute, served as experimental animals. The herd was screened for subclinical and clinical mastitis and 25 animals each with clinical and subclinical mastitis were randomly selected for sampling. Identical numbers of animals with healthy udders were also sampled for comparison.

The animals were stall fed with identical diets formulated by the Feed Technology Division of the Institute and comprised concentrates, green forages and drinking water. Diagnosis and classification of clinical mastitis were based on physical examination of the udder, physical and chemical examination of the milk. California mastitis test (CMT) and somatic cell count (SCC) were used to diagnose subclinical mastitis (Doxey, 1983).

Sampling

Blood samples were collected in nitric acid-washed heparinized vials from all the selected animals viz. 25 clinical and 25 subclinical mastitic animals. Similarly, blood samples from 25 healthy cows of similar ages and stages of lactation were also collected.

Feed, fodder and water

Samples of feed (6) and water (6) provided to these animals were collected in polythene bags and nitric acid-washed vials, respectively for assessment of mineral profile as per the method recommended by Wheeler and Fell (1983).

The samples of blood, feed, fodder and water were digested as per the method of AOAC (1984). Briefly, 5 ml of blood/ 5 ml of water/ 1 gram of feed material were mixed with 5 ml of nitric acid in digestion tubes and kept overnight at room temperature. The samples were then heated until the volume was reduced to 1 ml. Five ml double acid mixture (nitric acid 4 parts, perchloric acid 1 part)

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was then added to the sample. The samples were digested till the volume was reduced to 1 ml, attaining transparency and white colour. The digested samples were diluted with triple distilled water to make the final volume to 10 ml.

Micro-minerals (Zn, Cu and Co) in acid digest were estimated by atomic absorption spectrophotometery (AAS 4129 ECIL, Hyderabad India). Analytical quality was maintained by repeated analysis of reference samples. Standard solutions were prepared freshly from stock standards supplied by Sigma company, USA for calibration (Dey and Swarup, 1996). The results were analysed statistically using analysis of variance (Snedecor and Cocharan, 1967).

RESULTS

Concentration of the three minerals in feed, fodder and water routinely taken by these animals are presented in table 1. Green forages taken by these animals contained 328.6±9.61, 8.40±1.90 and 4.24± 0.90 ppm of Zn, Cu and Co, respectively. Concentrations of these elements in concentrate feed were 34.30±2.58, 17.30±1.30 and 1.85±0.08 ppm of Zn, Cu and Co, respectively. The drinking water contained 0.21±0.03 ppm Zn, 0.12±0.01 ppm Co and less than 0.02 ppm Cu. Table 2 shows the blood mineral profiles of healthy cattle and of cows suffering from mastitis. In cows with healthy udders, the mean Zn, Cu and Co concentrations were 8.46± 1.10, 0.62±0.02 and 0.40±0.03 ppm, respectively. In cows with subclinical mastitis, blood Zn, Cu and Co were respectively 5.66±0.52, 0.65±0.03 and 0.48± 0.03 ppm, and in cows suffering from clinical forms of mastitis were 6.76±0.98, 0.63±0.06 and 0.45± 0.04 ppm. Blood Zn level was found to be reduced significantly ($p<0.05$) in cows with subclinical mastitis compared to healthy animals. In animals with clinical mastitis, too, the blood Zn concentration was also reduced, though nonsignificantly ($p>0.05$).

DISCUSSION

Trace minerals play a vital role in human and animal health. In this study, in spite of the fact that cows under study had almost identical production during the few days prior to occurrence of mastitis blood Zn concentration decreased significantly ($p<0.05$) during subclinical mastitis. Though blood Zn level decreased in clinical mastitis, the alteration did not reach statistical significance ($p<0.05$). None of these animals showed signs of anorexia. And the decrease in zinc cannot be solely attributed to increased excretion in milk. Some workers have reported that utilization of essential elements increases during inflammation (Janota Bassalik et al., 1985; Kishore et al., 1983; Sturniolo et al., 1983). The possibility exists that interaction between toxins and enzymes released by the causative agents, and the myoepithelium may activate the utilization of elements. It may also be that during inflammation of the mammary gland, metabolism of its cells might have been increased to

Table 1. Concentrations (mean±SE; range in parentheses) of micro-elements in ppm in feed, fodder and water

Mineral	Type of sample		
	Green forage (6)*	Concentrate (6)*	Water (6)*
Zinc	328.6±9.61 (301.7-360.4)	34.30±2.58 (25.40-42.60)	0.21±0.03 (0.12-0.35)
Copper	8.40±1.90 (3.50-14.60)	17.30±1.30 (12.40-21.60)	<0.02
Cobalt	4.24±0.90 (2.10-7.25)	1.85±0.08 (1.62-2.21)	0.12±0.01 (0.08-0.16)

* Total number of composite samples.

Table 2. Concentration (mean±SE; range in parentheses) of micro elements in blood of healthy and mastitic animals in ppm

Mineral	No. of animal	Healthy	Subclinical	Clinical
Zinc	25	8.46±1.10 (3.88-16.82)	5.66±0.52* (3.64-8.82)	6.76±0.98 (3.72-13.92)
Copper	25	0.62±0.02 (0.51-0.72)	0.65±0.03 (0.37-0.82)	0.63±0.06 (0.27-0.87)
Cobalt	25	0.40±0.03 (0.28-0.63)	0.48±0.03 (0.28-0.67)	0.45±0.04 (0.28-0.73)

* Denotes values differ significantly ($p<0.05$) compared to healthy group.

cause a deficiency of Zn, which is a major component of metabolic enzymes (Nockles, 1988; Nckels and Blair, 1996). The difference in blood Zn level between clinical and subclinical mastitis might be due to a higher demand for Zn during critical or subclinical stages of inflammation. No significant difference was found in blood Cu and Co levels between healthy and mastitic cows. Judicious incorporation of zinc during mastitis may reduce the severity of the disease process and could bring about faster recovery.

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