USE OF A SOLUBLE GLASS BOLUS FOR SUPPLEMENTATION OF COPPER AND SELENIUM TO COWS

T. Matsui, T. Inui and T. Harumoto
Shimane University, Matsue 690, Japan

H. Yano
Kyoto University, Kyoto 606, Japan

and

Y. Yoden and R. Igarashi
Chugoku National Agricultural Experiment Station, Oda 694, Japan

Introduction

It has been known that the values of selenium (Se) content in grasses are generally much lower than that of dietary requirements for cattle and those of copper (Cu) contents are sometimes below the value of feed requirements of Cu in Japan. However, there are few trials of supplying these elements to grazing cows because of difficulties of the method of supplementation. Recently the phosphorus based soluble glass was developed for supplying some trace elements to ruminants (Telfer et al., 1983). This experiment was designed to investigate the effect of administration of the soluble glass bolus containing Cu and Se on concentrations of these elements in blood of grazing cows.

Materials and Methods

Twenty Japanese Black cows which had been housed in winter, were divided into 2 groups 1 month after opening of grazing. Each of 11 cows in the first group orally received a glass bolus (treated) and the other 9 cows were untreated (control). Samples of blood were collected at the time of administration of the bolus and at monthly intervals for 5 months. Samples of grasses and legumes were collected from pastures at the same time. The soluble glass bolus used in this experiment weighed about 36 g and contained 2.9% Cu and 0.27% Se. The mean release rate for 3 months is expected 10.8 mg/day for Cu and 1.01 mg/day for Se. Cu concentration in plasma and forages were measured by atomic absorption spectrophotometry and Se concentration in whole blood and forages were determined by the fluorometric method (Watkinson, 1966).

Results and Discussion

Cu contents in more than half of forages were less than 8 mg/kg D.M. Especially, Cu content in tall fescue, which was assumed to be the mainly ingested forage species, was 5.3 mg/kg D.M. on the average. The suggested value of feed requirements of Cu for beef cattle is 8 mg/kg D.M. and the range of Cu requirements is between 4 and 10 mg/kg D.M. (N.R.C., 1984). These results suggest that Cu may not be deficient but Cu had better be supplied to cows during grazing on these pastures.

Cu concentration in plasma was tended to be higher in treated cows than in control ones for 4 months after the administration of glass bolus and the difference in plasma Cu level between treated and control cows was significant ($p < 0.05$) 1 month after the administration. The lowest level of plasma Cu was 0.62 mg/l in the control group during the experimental period. This value was close to the marginal one which is borderline to

TABLE 1. COPPER AND SELENIUM CONTENTS IN GRASS AND LEGUMES

Months after administration of the bolus	Copper (mg/kg D.M.)		Selenium (μg/kg D.M.)	
	Mean	Range	Mean	Range
0	6.3	5.7- 6.8	34.2	32.3-36.0
1	6.6	5.0- 8.1	25.7	20.2-31.2
2	8.7	4.9-11.7	23.3	16.6-42.3
3	7.0	4.7-10.9	30.6	12.6-60.0
4	9.9	6.1-10.9	29.7	17.9-25.0
5	5.8	2.1-12.8	29.5	18.8-50.2

TABLE 2. THE EFFECT OF GLASS BOLUS ADMINISTRATIONS ON PLASMA COPPER AND BLOOD SELENIUM CONCENTRATION IN GRAZING COWS

Months after administration of the bolus	Copper (mg/l)			Selenium (μg/l)		
	Mean	S.E.	Range	Mean	S.E.	Range
			Treated			
0	0.86	0.07	0.61-1.33	76.5	5.7	26-101
1	1.03	0.03*	0.90-1.21	78.5	4.3*	53-95
2	0.95	0.03	0.75-1.17	68.9	5.0	37-90
3	0.97	0.05	0.77-1.30	56.8	3.0*	34-71
4	1.13	0.04	0.86-1.39	56.0	2.8	41-73
5	1.04	0.05	0.77-1.22	59.2	2.2	51-71
			Control			
0	0.95	0.10	0.64-1.40	71.7	4.9	49-96
1	0.91	0.04	0.73-1.16	63.2	4.6	41-87
2	0.89	0.02	0.83-1.04	55.7	6.3	23-85
3	0.85	0.04	0.62-1.02	44.4	5.2	22-66
4	1.05	0.07	0.62-1.38	45.2	5.3	24-85
5	1.04	0.05	0.72-1.28	52.0	3.8	34-74

* Significantly ($p < 0.05$) different from control.

deficient state. On the other hand, the lowest value of Cu concentration was 0.75 mg/l in the treated group. These results suggested that the soluble glass bolus is available for supplying Cu to grazing cows for 4 months.

Se content in almost all of forages were below 50 μg/kg D.M. These values were much lower than the dietary requirements of Se for beef cattle (N.R.C., 1984), indicating that Se must be supplied to cows grazing on these pastures.

Se concentration in blood tended to be decreased in both groups during the experiment. Because cows were fed some cereals which contained adequate amounts of Se before pasturing, blood Se concentration at the beginning of this experiment was thought to be high. And blood Se level reduced during grazing associated with the ingestion of forages containing low Se.

The tendency of reducing Se concentration in blood was more remarkable in control cows compared to treated ones until 4 months after the bolus administration. And blood Se levels were significantly higher ($p < 0.05$) in the treated group in 1 and 3 months after the administration. It is suggested that the efficacy of the supplementation of Se lasts, at least, 4 months. These results were consistent with the observation of Cu. The lowest value of blood Se concentration was 34 μg/l in treated cows, which might be within a normal range of blood Se. On the other hand, it is possible that Se concentration in blood becomes lower in year long grazing cows on these pastures without supplying Se rich concentrate though they are administrated the glass bolus. It is conceivable that the administration of glass bolus is one of the best way to supply Se to grazing cattle while the glass bolus had better contain more Se for year long grazing cattle.

(Key Words: Copper, Selenium, Soluble Glass Bolus)

Literature Cited

National Research Council. 1984. Nutrient Requirements: Excesses and deficiencies. In "Nutrient Requirements of Beef Cattle", National Academy Press, pp.2-28.

Telfer, S.B., G. Zervas and P. Knott. 1983. Water soluble glass articles, their manufacture, and their use in the treatment of ruminant animals. U.K. Patent Application GB2116424A.

Watkinson, J.H. 1966. Fluorometric determination of selenium in biological material with 2,3-diaminonaphthalene. Anal. Chem. 38:92-97.