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Effects of Copper and Selenium Injections on Cow Productivity and Concentration of Copper in Liver Biopsy Samples

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In the conditions of the study when additional copper and selenium were provided, cow reproduction and calf performance were not improved.

Summary

A study with 100 cows in four treatment groups was conducted at the Gudmundsen Sandhills Laboratory. The treatment groups were: 1) Control, no additional Cu or Se, 2) 120 mg Cu, 3) 25 mg Se, or 4) 120 mg Cu and 25 mg of Se. In 1993, treated cows received Cu by injection and Se supplementation by bolus in January and June. In 1994, Se was provided by injection instead of Se bolus in the same months. In 1995, injections of Cu and Se were given in January only. Reproductive performance and calf performance were not influenced by treatment.

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Introduction

Copper and Se are trace elements important in several aspects of normal body function; therefore, a diet deficient in these elements may impair productivity in the cow herd. The purpose of the following study was to determine if providing additional Cu and/or Se by injection at manufacturer's recommended levels two times during the year improves cow productivity and changes concentration of Cu in liver biopsy samples of cows or their calves.

Procedure

One-hundred 4- to 6-year-old MARC II cows were randomly assigned to one of four groups. The study was conducted at the Gudmundsen Sandhills Laboratory at Whitman, NE. One of the following treatments was assigned to a group of cows for three years: 1) control untreated, 2) Cu injection, 3) Se bolus/injection, and 4) combination of Cu and Se. Treated cows received Cu by injection and Se supplementation by bolus (MolyCu® and DuraSe® boluses; Schering-Plough) in January and June, 1993. In the same months in 1994 Cu was again injected, but Se was supplemented by injection (Mu-Se®; Schering-Plough) instead of the DuraSe® boluses. Dosage was according to field recommendations; 2 cc of MolyCu® (400 mg of cupric glycinate) was the equivalent of 120 mg Cu. The DuraSe®-120 bolus contained the equivalent of 360 mg Se as sodium selenite and was manufactured to deliver a controlled amount of 3 mg/Se/day for four months. Mu-Se® was injected at 1 ml/200 lb body weight. Each ml contained 10.95 mg sodium selenite (equivalent to 5 mg selenium). Cows received treatments in January, but not June of the third year (1995). The cows were managed as a single herd with energy and protein supplementation provided as needed to maintain moderate body condition scores at calving.

In January and June (1993 and 1994), ten cows from each group were liver

Table 1. Reproductive performance data by treatment group within years (least square means)

	Calving rate (number of cows calving)			
	Control	Cu	Se	Cu & Se
1993	25	25	24	25
1994	22	25	23	23
1995	20	22	20	22
	Calving date[a]			
	Control	Cu	Se	Cu & Se
1993	86	89	92	87
1994	87	87	91	84
1995	82	88	87	85
	Calving interval (mean days)			
	Control	Cu	Se	Cu & Se
1994	367	364	365	365
1995	358	368	361	365

[a]Julian days where 1 = January 1 and 90 = March 31.

Table 2. 205 day adjusted weaning weights (lb) by treatment group with year (least square means)

Item	1993	1994	1995	SEM
Control	557	578	478	22
Cu	563	583	435	22
Se	574	563	495	21
Cu & Se	527	555	475	22

Table 3. Least square means for cow liver Cu by treatment group with year (ppm, dry basis)

Biopsy date[a]	Control	Cu	Se	Cu & Se	SEM
January, 1993	107^{bc}	112^{bc}	138^{b}	94^{c}	15
June, 1993	86^{bc}	108^{b}	89^{bc}	74^{c}	11
January, 1994	110	108	111	101	11
June, 1994	85	95	82	74	11
March/April, 1995	51^{bc}	74^{b}	47^{c}	54^{bc}	11

[a]Biopsy date (P<.01); Treatment (P<.10); Treatment * Biopsy date (P<.75).
[b,c]Means within rows with different superscripts are different (P<.10).

Table 4. Calf liver biopsy (ppm, dry basis) data (least square means)

Element	Control	Cu	Se	Cu & Se	SEM
Mo	1.5	1.4	1.3	1.5	.1
Cu	200	216	179	271	31
Zn	165	156	155	199	30
Mn	7.5	7.5	7.0	7.1	.5

Table 5. Gudmundsen Sandhills Laboratory hay analysis by harvest date

	Cu (ppm)				Mo (ppm)				Zn (ppm)				Mn (ppm)			
Year	High	Low	Mean	# of samples	High	Low	Mean	# of samples	High	Low	Mean	# of samples	High	Low	Mean	# of samples
1992	8.8	2.8	5.9	18	10.1	2.9	5.9	18	23.6	16.4	19.8	18	412.5	41.9	142.7	18
1993	8.8	3.5	6.2	23	10.6	2.6	5.9	23	25.4	14.8	19.5	23	206.3	39.5	118.1	23
1994	10.1	2.4	6.6	23	9.9	1.7	5.4	23	30.0	13.1	19.4	23	645.5	64.0	174.3	23

biopsied and blood serum was collected. Cow weight and body condition score were recorded in January, June, and October. Calves were weighed and serum samples taken at birth. Calves were weighed in May and October. In March/April 1995, calves (average age = 23 days) from liver biopsied cows were liver biopsied at the same time as the cows. Serum and liver biopsy tissue were analyzed for macro and microelements using an inductively coupled argon plasma atomic emission spectrometer.

Samples of hay harvested from pastures on the ranch were collected each year and analyzed for mineral elements by x-ray diffraction.

Results

Pregnancy rate, calving date, and calving interval were not affected by treatment or year (Table 1). No differences were observed in calf birth weight or calf weight among treatments. There was a significant year effect on weaning weight (Table 2) with weaning weights being lower for 1995 (P<.01).

Tables 3 and 4 show the cow and calf liver biopsy data, respectively. Liver biopsy Cu concentrations were significantly lower in the March/April 1995 samples. The difference may be due to date and that it immediately followed calving. Cows provide Cu to the fetus during the last weeks of pregnancy. Copper concentrations in liver biopsy samples from cows injected with Cu were higher than other groups at several biopsy dates, including March/April 1995. However, increases in concentration of Cu in the liver biopsy samples did not alter reproductive or calf performance. The combination of Cu and Se did not increase Cu in liver biopsy samples. There is limited research suggesting that Se is an antagonist to Cu absorption.

No treatment effects on trace element percentages in calf liver biopsy samples were observed (Table 4). The concentration of Cu was higher in calf liver biopsy samples than cow liver biopsy samples: a relationship between concentration of Cu in calf liver biopsy samples and cow liver biopsy samples was not observed. Cows with high concentrations of Cu in liver biopsy samples did not have calves with higher or lower Cu in their liver biopsy samples as indicated by non-significant correlation coefficients. Calf liver biopsy samples were taken only in year three, so year and treatment by year interactions were not available.

The analysis of hay samples suggest the mean Cu content of the forages consumed by cows during this study contained between 5.9 and 6.6 pm Cu (Table 5). Actual intake of Cu was not available, because samples representative of the forage the cows were consuming during the grazing season were not collected. Based on data reported in the 1994 Nebraska Beef Report, p. 9, the forage the cows consumed during the grazing season should have had greater than 6 ppm Cu, because forages in the early stages of physiological growth tend to have higher concentrations of Cu. The mean molybdenum content of hay samples varied by year between 5.4 and 6.0 ppm (Table 5); however, variability in molybdenum analysis was large in hay samples from pasture to pasture. Analytical methods for Mo are complex and may explain a large portion of the variability.

In this study injections of Cu and Se did not affect reproductive performance or calf performance through weaning. The relationship of lower calf performance and lower Cu concentration in their dam's liver biopsy samples observed in 1995 warrants further study with more closely monitored Cu consumption and additional liver biopsy samples from cows and calves. Furthermore, the Cu-Se interaction suggested by lower Cu concentration in liver biopsy samples from cows given both Cu and Se compared to other treatments may require additional study.

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