

Effect of copper source and copper antagonist level on the performance and indicators of copper status in dairy cows.

Research Partnership: Cattle health, welfare and nutrition

Work Package FS3: Mineral and trace-element requirements of dairy cows

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This study was conducted to determine the effect of form of copper (Cu) source (CuSO₄ or a Cu containing bolus) and level of the Cu antagonists sulphur (S) and molybdenum (Mo), on health and indicators of Cu status in dairy cows. Fifty six Holstein-Friesian dairy cows (12 primiparous and 44 multiparous) that were 97 days into lactation were allocated to one of four diets as follow:

- C- CuSO₄ with no additional antagonists
- C+ CuSO₄ with added S and Mo
- B- Cu containing bolus with no additional antagonists
- B+ Cu containing bolus with added S and Mo

The CuSO₄ was added to C- and C+ to provide a similar daily supply of Cu to that released from the bolus, with S and Mo added to C+ and B+ to provide an additional 1.5g S/kg DM and 7mg Mo/kg DM. Blood samples were collected via jugular venepuncture during weeks 0, 2, 4, 8 and 14 of the study, and liver biopsy samples were obtained from each cow during weeks 0 and 14. Milk yield and intake were recorded daily, with samples collected weekly for subsequent analysis of fat, protein and lactose. Somatic cell count (SCC) along with weight and body condition were determined fortnightly. Summary results are presented in Table 1.

Table 1. Intake, performance and indicators of Cu status of dairy cows either CuSO₄ or a Cu containing bolus without (-) or with (+) added S and Mo.

	Diets				s.e.d.	Significance ^a		
	C-	C+	B-	B+		S	A	Int
Intake, kg DM/d	22.8	21.1	23.0	22.2	0.84	0.324	0.041	0.438
Milk yield, kg/d	33.9	33.9	34.3	34.0	0.94	0.651	0.856	0.822
Fat, g/kg	42.2	44.0	43.8	43.0	2.61	0.866	0.778	0.494
Live weight, kg	661	647	644	660	20.6	0.908	0.937	0.298
Milk SCC, log ₁₀	1.85	1.76	1.87	1.87	0.084	0.270	0.486	0.378
Liver minerals								
Final Cu, mg/kg DM	550	432	586	476	31.6	0.087	<0.001	0.878
Cu change, mg/kg DM	-0.75	-1.95	-0.37	-1.50	0.323	0.087	<0.001	0.878
Final Mo, mg/kg DM	3.35	4.04	3.56	3.78	0.201	0.807	0.004	0.093
Plasma Cu, µmol/l	14.2	14.1	14.1	13.9	0.86	0.800	0.821	0.969
Plasma Mo, µmol/l	0.24	0.48	0.24	0.53	0.037	0.425	<0.001	0.326
SOD ^b U/g Hb	2337	2225	2257	2165	76.8	0.254	0.064	0.865

^aP values; S = main effect of copper source, A = main effect of antagonists, s.e.d. = standard error of difference, Int = interaction between copper source and antagonists, ^bSOD = Superoxide dismutase

In conclusion:

- Source of Cu had no effect on DM intake, but adding S and Mo decreased DM intake by 1.2 kg/d
- Source of Cu had no effect on animal performance or somatic cell count
- Liver Cu concentrations decreased in cows fed any of the dietary treatments. There was a strong and negative effect of added S and Mo, with liver Cu concentrations decreasing on average by 1.7mg/kg DM/d in these treatments
- The rate of decline of liver Cu tended to be less in cows receiving a bolus

- Plasma superoxide dismutase (SOD) values tended to be lower in cows when fed added S and Mo
- Plasma Cu was not affected by antagonist level despite liver Cu declining with the inclusion of S and Mo. Plasma Cu is therefore not suitable in determining the Cu status of cattle
- Farmers should have their forages tested for mineral concentrations before deciding on a mineral supplementation strategy for their cattle.

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