



The influence of trace minerals source on copper, manganese, and zinc binding strength to rumen digesta in cattle fed a high forage-based diet.



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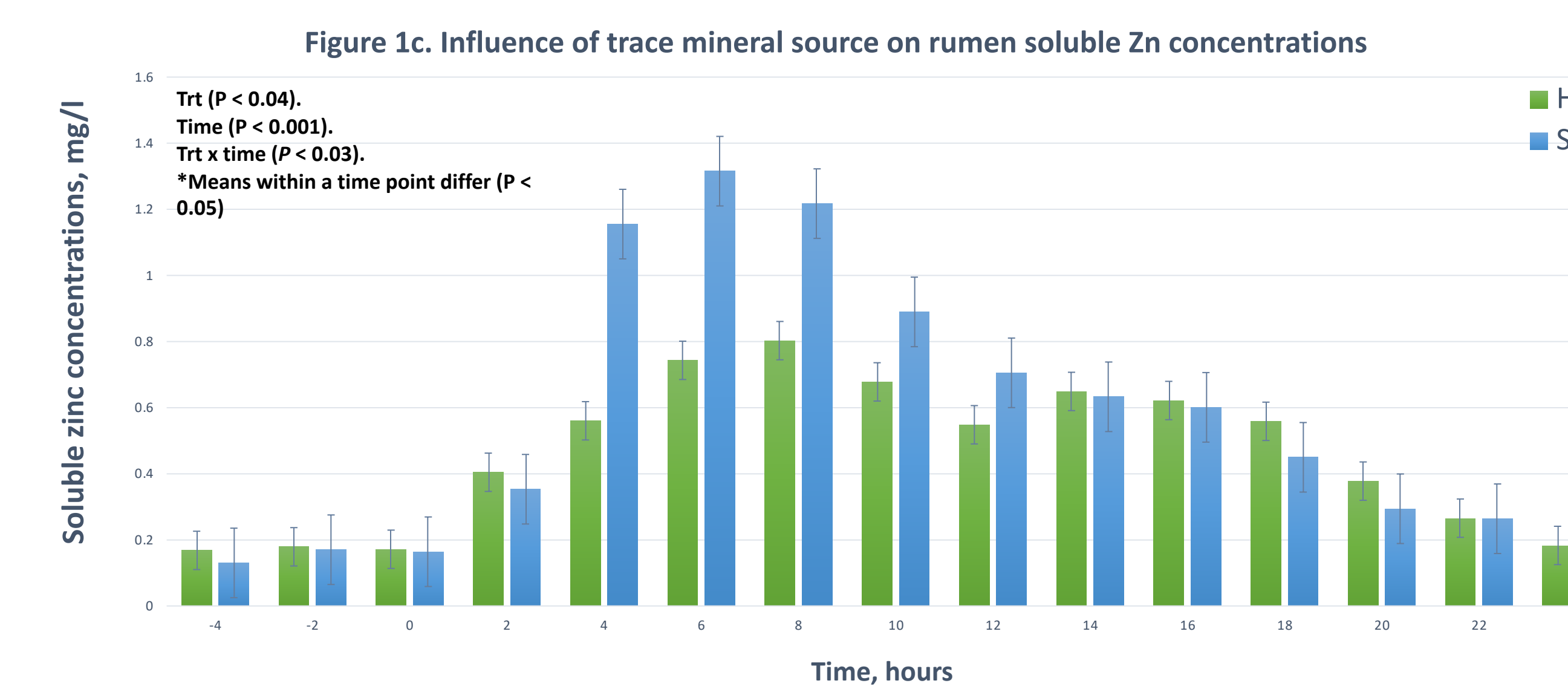
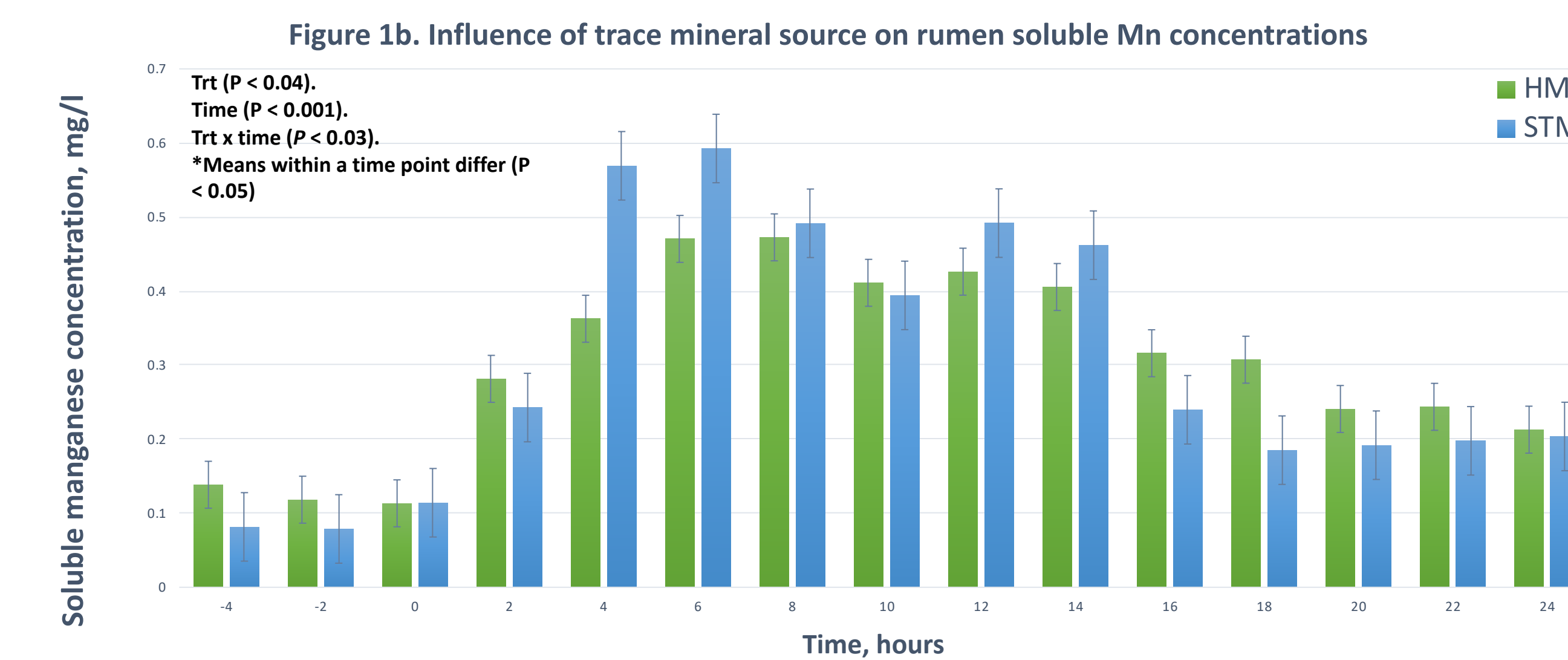
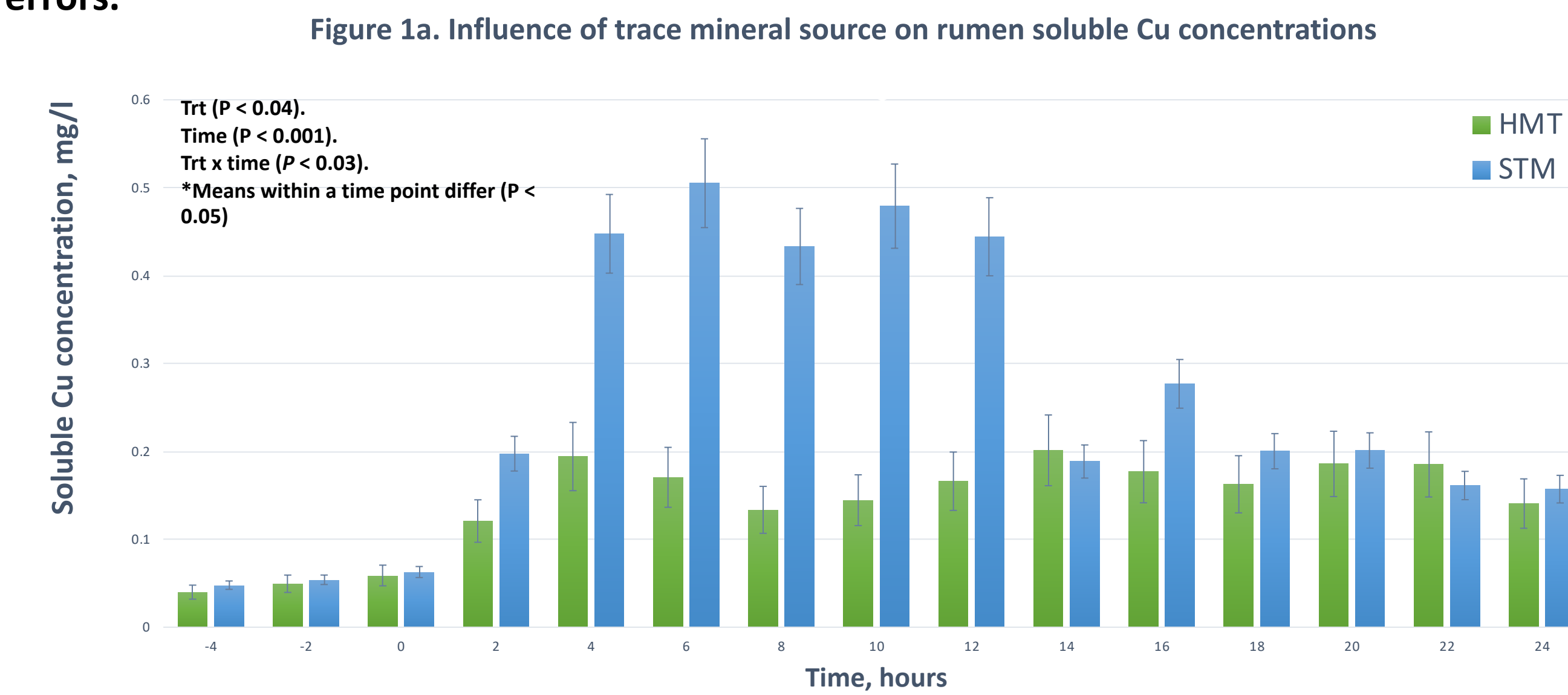
ABSTRACT

Twelve crossbred Angus steers fitted with rumen cannulae were used to determine the influence of trace mineral source on ruminal soluble mineral concentrations and relative binding strength of trace minerals in the ruminal insoluble digesta fraction. Steers were adjusted to a low-quality hay (chopped) diet balanced to meet the nutrient requirements for growing steers. For 7 d prior to initiation of the study steers were fed the diet without supplemental Cu, Mn, and Zn. On day 8 steers received a pulse dose (2 x NRC requirement) of Cu, Mn, and Zn from sulfate (STM) or hydroxy trace minerals (HTM). Ruminal samples were obtained at 2 h intervals until 24 h post-dosing for soluble (fraction obtained after centrifugation) Cu, Mn, and Zn concentrations. Binding strength of Cu, Mn, and Zn to ruminal solid digesta (post centrifugation) was estimated at 0, 12, and 24 h post-dosing using dialysis against 0.05 M Tris-EDTA. Ruminal soluble mineral concentrations were greater ($P < 0.05$) for Cu at 4, 6, 8, 10, 12, and 16 h; for Mn at 4 and 6h; and for Zn at 4, 6, and 8h post dosing in STM compared to HTM steers. Concentration of Cu remaining in the insoluble fraction were greater ($P < 0.05$) at 12h and at 24h ($P < 0.03$) post dosing in HTM vs STM supplemented steers. At 24 h post dosing, Zn concentrations were greater ($P < 0.001$) in HTM vs STM supplemented steers. Following dialysis, the % Cu, Mn, and Zn released from the insoluble fraction at 0h were similar across the treatments. However, the % of Zn released at 12h was greater ($P < 0.03$) in HTM versus STM. Whereas, Cu and Zn were greater ($P < 0.05$) at 24h in HTM vs. STM supplemented steers. Results indicate that a greater proportion of HTM remained loosely bound to the insoluble fraction within the rumen.

MATERIALS AND METHODS

- 12 Crossbred Angus steers (BW 452.8 ± 21.8kg)
- Steers were fed the diet without supplement for 7 days → received treatment on day 8
- Treatments:
 - Experiment 1: 10 mg Cu/kg DM, 40 mg Mn/kg DM, and 60 mg Zn/kg DM, from either sulfate (SO₄) or hydroxy (IntelliBond) sources
- Ruminal samples were obtained at 2h intervals until 24h post-dosing for soluble (fraction obtained after centrifugation).
- Binding strength of Cu, Zn, and Mn to rumen digesta was determined through dialysis against 0.05 M Tris-EDTA.

The influence of trace mineral source on soluble Cu, Mn, and Zn within the ruminal contents of steers receiving a pulse dose of either STM or HTM with 10mg copper, 40 mg manganese, and 60 mg zinc/kg DM. The x-axis denotes sampling time in hours, the y-axis denotes rumen soluble copper (Figure 1a), manganese (Figure 1b), and zinc (Figure 1c). Error bars represent standard errors.



RESULTS

Influence of dialysis on copper, manganese, and zinc release from rumen solid digesta 0, 12, and 24 hours after receiving a pulse dose of 10mg copper, 40 mg manganese, and 60 mg zinc/kg DM from either hydroxy or sulfate TM sources.

Item	Treatment			
	HTM	STM	SEM	P <
Initial mineral concentration of digesta, mg/kg DM				
0 hour				
Copper	1.4	1.5	0.34	0.95
Manganese	8.4	8.6	1.1	0.91
Zinc	9.3	10.2	0.91	0.78
12 hours				
Copper	21.2	6.5	2.8	0.05
Manganese	15.3	14.9	2.9	0.65
Zinc	47.3	21.3	7.2	0.11
24 hours				
Copper	28.2	5.1	2.3	0.03
Manganese	28.3	24.5	4.2	0.89
Zinc	112.3	30.2	10.3	0.001
Tris-EDTA, (0.01M ethylenediaminetetraacetate in 0.05M tris-hydroxymethyl-aminomethane)				
% Released				
0 hour				
Copper	24.5	29.3	1.9	0.82
Manganese	37.2	41.2	4.3	0.72
Zinc	54.3	46.9	3.8	0.73
12 hours				
Copper	61.2	28.3	7.1	0.06
Manganese	71.2	75.9	21.3	0.82
Zinc	92.3	37.2	12.3	0.03
24 hours				
Copper	84.5	24.3	18.4	0.02
Manganese	91.2	94.3	15.3	0.73
Zinc	92.3	28.6	12.7	0.05

DISCUSSION

- ❖ Zn and Cu concentrations in ruminal solid digesta were much greater in steers receiving HTM compared with STM. That suggest that STM may have exited the rumen at a faster rate than HTM.
- ❖ At 24h post dosing, Cu and Zn concentration are greater ($P < 0.001$) in HTM vs. STM supplemented steers.

CONCLUSION

- ❖ Results from this experiment indicate that Cu and Zn from HTM appear to be less tightly bound to solid digesta in the rumen than Cu and Zn from STM.