

**Table 1. Composition and chemical analysis
(DM basis) of the finishing ration**

Item		
Ingredient, % DM		SEM ¹
Alfalfa Hay	10.7	
Corn Silage	17.9	
Barley	71.4	
Chemical Analysis		
DM, % as fed	79	0.27
CP, %	13.1	0.09
Fat, %	2.19	0.02
Ash, %	6.59	0.06
Nem, Mcal/lb	0.82	0.003
Neg, Mcal/lb	0.54	0.003
TDN, %	77.22	0.25
Mineral composition		
Calcium, %	0.3	0.01
Phosphorous, %	0.32	0.003
Magnesium, %	0.18	0.004
Potassium, %	0.97	0.02
Sodium, %	0.04	0.002
Iron, ppm	124	28.42
Manganese, ppm	43	2.77
Zinc, ppm	49	1.95
Copper, ppm	12	0.63
Selenium, ppm	0.14	0.01

¹Standard error of the mean (SEM)

Table 2. Composition of mineral mix (DM basis) added to ration¹

Item	
Ingredient, %DM	
Calcium, %	5.81
Chlorine, %	0.11
Magnesium, %	1.47
Sulphur, %	0.11
Cobalt, ppm	178.76
Copper, ppm	7,156.28
Copper, ppm (chelate)	1,788.69
Iodine, ppm	463.70
EDDI, mg/lb	262.36
Manganese, ppm	17,075.81
Manganese, ppm (chelate)	4,268.95
Selenium, ppm	142.30
Selenium, ppm (chelate)	46.90
Zinc, ppm	23,881.04
Zinc, ppm (chelate)	5,970.07
Vit A, KIU/lb	540.32
Vit D, KIU/lb	129.47
Vit D-3, KICU/ lb	129.47
Vit E, IU/lb	5,174.52

¹Mineral was fed at 182.2 g/d to HM group (n = 10) and 91.1 g/d to AM group (n = 10)

Table 3. Comparison of trace mineral content between treatments and NRC requirements

	NRC req.	MM ¹	AM ¹	HM ¹
Cobalt, mg/kg	0.15	-	96.48%	180.81%
Copper, mg/kg	10	150%	73.66%	138.03%
Iodine, mg/kg	0.5	-	119.59%	224%
Manganese, ppm	20	50%	87.89%	164.68%
Selenium, mg/kg	0.1	5000%	155.81%	291.94%
Zinc, mg/kg	30	200%	81.94%	153.54%

¹Percent mineral value is the calculated amount of mineral provided in the supplement relative to National Research Council (NRC) requirements. (NRC, 2019).

Table 4. Average cortisol level of steers after travel

	Treatment ¹				SEM ²	P-value ³
	AM	CON	HM	MM		
Cortisol, ng/mL	34.385	35.591	35.465	35.277	3.430	0.99

¹Treatments include: a diet containing oral supplementation of minerals provided at levels similar to NRC requirements (AM; n = 10), oral supplementation of minerals provided at levels above NRC requirements (HM; n = 10), a MultiMin® injection at labeled dose (MM; n = 10) or no mineral supplementation (CON; n = 10).

²Standard error of the mean (SEM)

³P-value indicates the effect of treatment

Table 5. Average daily gain of steers during the feedlot phase

	Treatment ¹				SEM ²	P-value ³
	AM	CON	HM	MM		
Average daily gain, kg						
Days 0-13	2.5	2.53	2.81	2.97	0.27	0.55
Days 14-27	1.84	2.22	1.8	1.56	0.26	0.37
Days 28-40	1.8	2.03	2.19	0.71	0.46	0.12
Days 41-55	1.98	1.017	1.12	2.32	0.47	0.16
Days 56 - 69	0.82 ^{ab}	1.72 ^{ab}	3.05 ^b	0.34 ^a	0.46	0.05
Days 70 - 83	2.13	1.29	1.435	2.53	0.44	0.17
Days 84-109	1.29	1.45	2.06	1.41	0.26	0.18
Days 0-109	1.7	1.72	1.94	1.65	0.10	0.18

¹Treatments include: a diet containing oral supplementation of minerals provided at levels similar to NRC requirements (AM; n = 10), oral supplementation of minerals provided at levels above NRC requirements (HM; n = 10), a MultiMin® injection at labeled dose (MM; n = 10) or no mineral supplementation (CON; n = 10).

²Standard error of the mean (SEM)

³P-value indicates the effect of treatment

Table 6. Carcass Data

	Treatment ¹				SEM ²	P-value ³
	AM	CON	HM	MM		
HCW, kg	333.4	333.5	338.5	327.1	17.2	0.08
Marbling Score	410.9	424.2	551.2	405.7	24.9	0.75
Ribeye Area, cm ²⁰	73.6	75.4	74.6	73.0	2.1	0.88
Ribeye fat thickness, mm	7.62	7.44	7.65	7.14	0.25	0.50
Yield grade	2.3	2.3	2.3	2.1	0.16	0.76
Marb:BF ratio ³	-0.33	0.10	0.10	0.12	0.32	0.72

¹Treatments include: a diet containing oral supplementation of minerals provided at levels similar to NRC requirements (AM; n = 10), oral supplementation of minerals provided at levels above NRC requirements (HM; n = 10), a MultiMin® injection at labeled dose (MM; n = 10) or no mineral supplementation (CON; n = 10).

²Standard error of the mean (SEM)

³P-value indicates the effect of treatment

⁴Marbling to backfat ratio was determined using the calculations previously described by Mohrhauser et al., 2015a. $[(\text{observation marbling score} - \text{marbling score } \bar{x}) / \text{marbling SD}] - [(\text{observation backfat} - \text{backfat } \bar{x}) / \text{backfat SD}]$

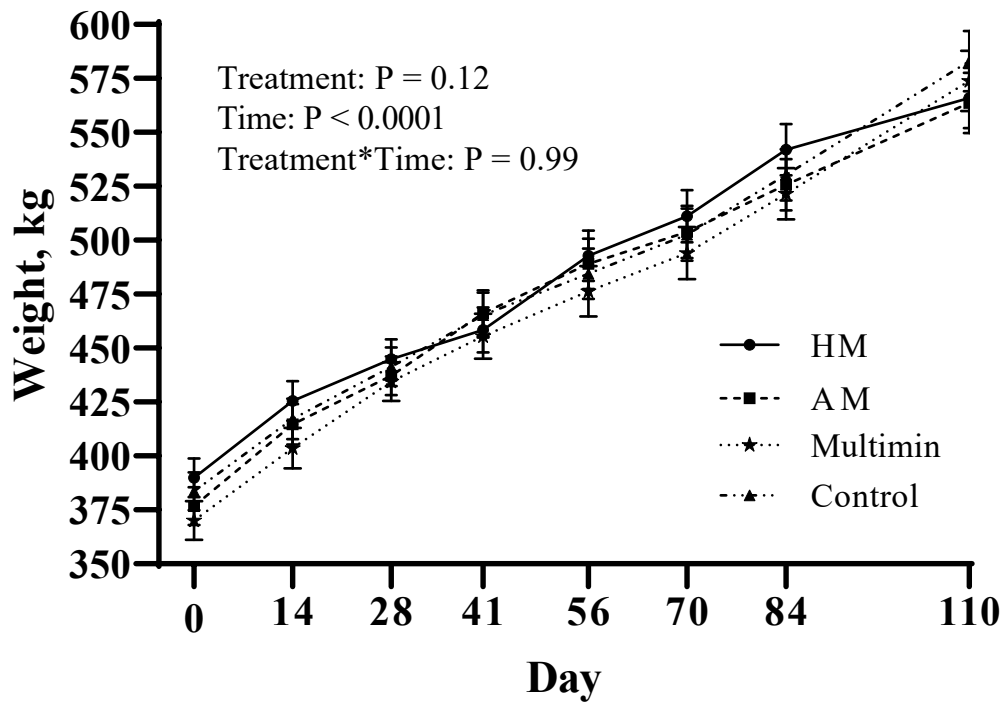


Figure 1. Average weight gain over 110 d finishing period in steers receiving a diet containing oral supplementation of minerals provided at levels similar to NRC requirements (AM; n = 10), oral supplementation of minerals provided at levels above NRC requirements (HM; n = 10), a MultiMin® injection at labeled dose (MM; n = 10) or no mineral supplementation (CON; n = 10) for the first 40 d of the trial. Values are represented as the least squares mean \pm SEM. P-values of repeated measure analysis for the fixed effects of treatment, time and their interaction are indicated in the top left corner of the graph.

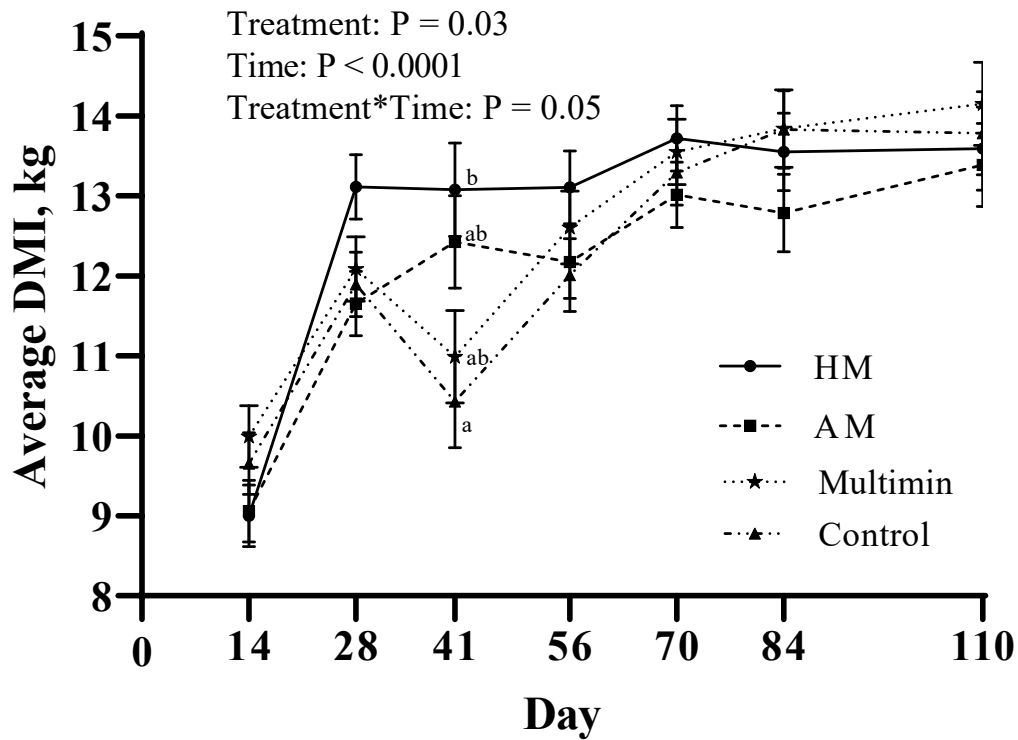


Figure 2. Average dry matter intake (DMI) over 110 d finishing period in steers receiving a diet containing oral supplementation of minerals provided at levels similar to NRC requirements (AM; n = 10), oral supplementation of minerals provided at levels above NRC requirements (HM; n = 10), a MultiMin® injection at labeled dose (MM; n = 10) or no mineral supplementation (CON; n = 10) for the first 40 d of the trial. Values are represented as the least squares mean ± SEM. P-values of repeated measure analysis for the fixed effects of treatment, time and their interaction are indicated in the top left corner of the graph. Time points with different letters indicate a difference (P < 0.05) between the different treatments at that specific time point.

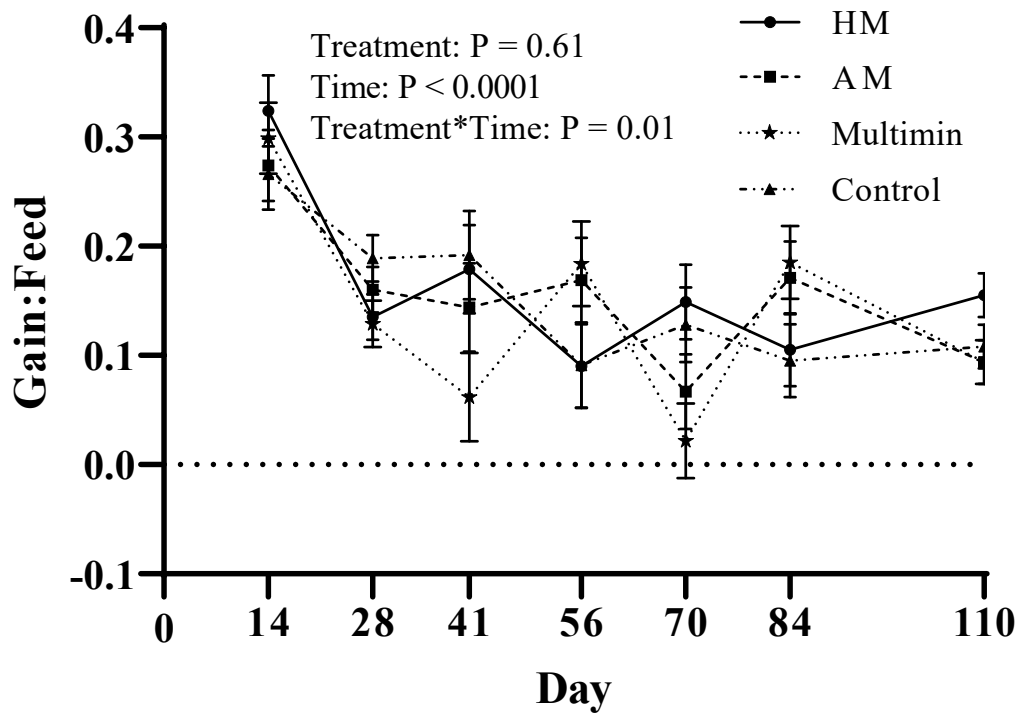


Figure 3. Average gain:feed ratio over 110 d finishing period in steers receiving a diet containing oral supplementation of minerals provided at levels similar to NRC requirements (AM; n = 10), oral supplementation of minerals provided at levels above NRC requirements (HM; n = 10), a MultiMin® injection at labeled dose (MM; n = 10) or no mineral supplementation (CON; n = 10) for the first 40 d of the trial. Values are represented as the least squares mean ± SEM. P-values of repeated measure analysis for the fixed effects of treatment, time and their interaction are indicated in the top left corner of the graph.

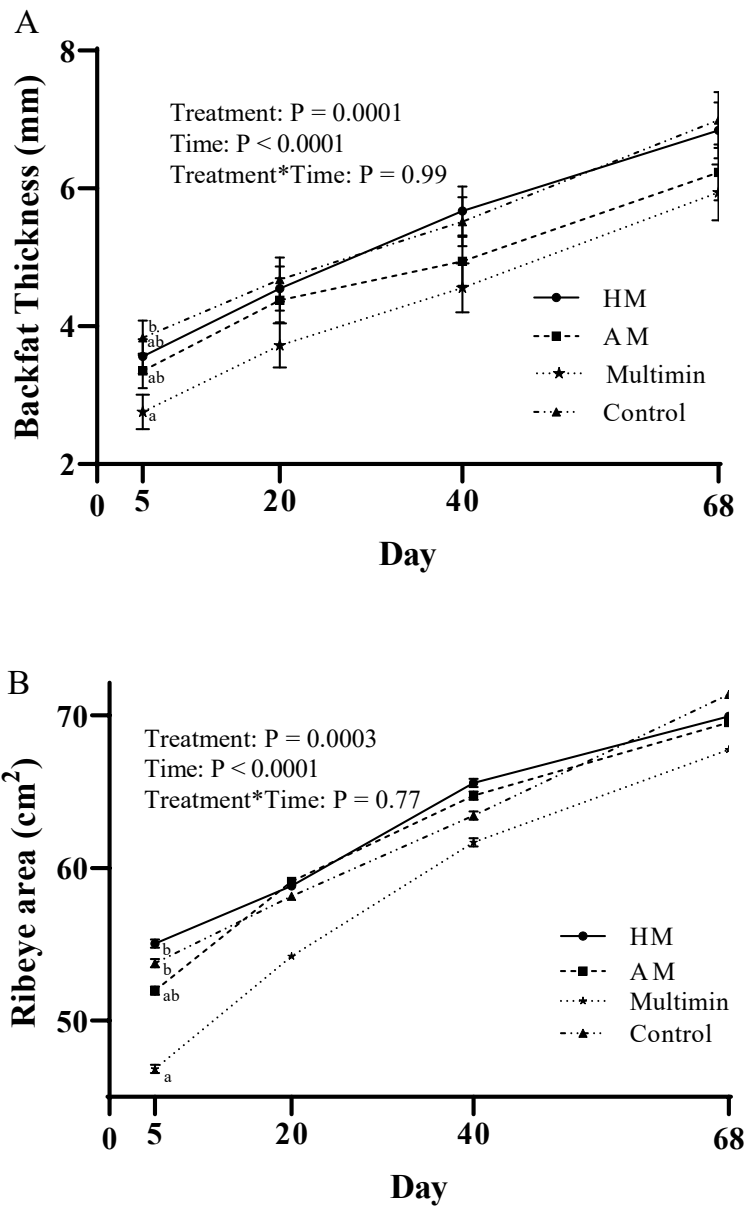


Figure 4. Mean backfat thickness (A) and ribeye area (B) of finishing steers as measured by ultrasound over the 110 d finishing period in steers receiving a diet containing oral supplementation of minerals provided at levels similar to NRC requirements (AM; $n = 10$), oral supplementation of minerals provided at levels above NRC requirements (HM; $n = 10$), a MultiMin® injection at labeled dose (MM; $n = 10$) or no mineral supplementation (CON; $n = 10$) for the first 40 d of the trial. Values are represented as the least squares mean \pm SEM. P-values of repeated measure analysis for the fixed effects of treatment, time and their interaction are indicated in the top left corner of each graph. Time points with different letters indicate a difference ($P < 0.05$) between the different treatments at that specific time point.

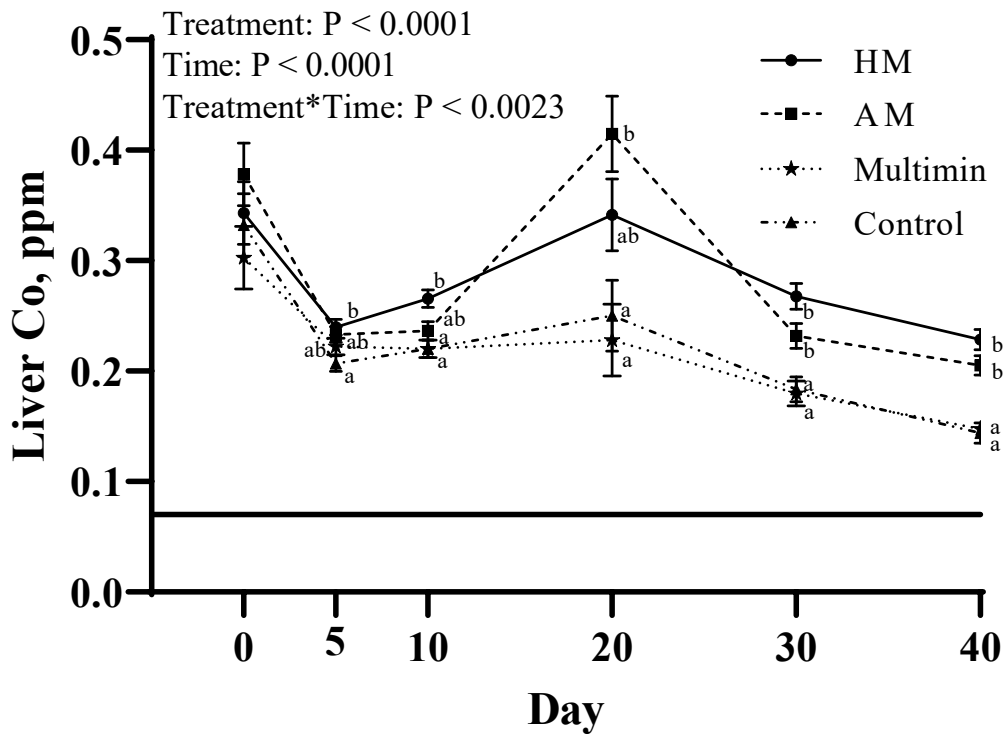


Figure 5. Mean hepatic cobalt (Co) concentrations of finishing steers receiving a diet containing oral supplementation of minerals provided at levels similar to NRC requirements (AM; n = 10), oral supplementation of minerals provided at levels above NRC requirements (HM; n = 10), a MultiMin® injection at labeled dose (MM; n = 10) or no mineral supplementation (CON; n = 10) for the first 40 d of the trial. Any value below the bold black line is indicative of a clinical deficiency. Values are represented as least squares mean \pm SEM. P-values of repeated measure analysis for the fixed effects of treatment, time and their interaction are indicated in the top left corner of the graph. Time points with different letters indicate a difference ($P < 0.05$) between the different treatments at that specific time point.

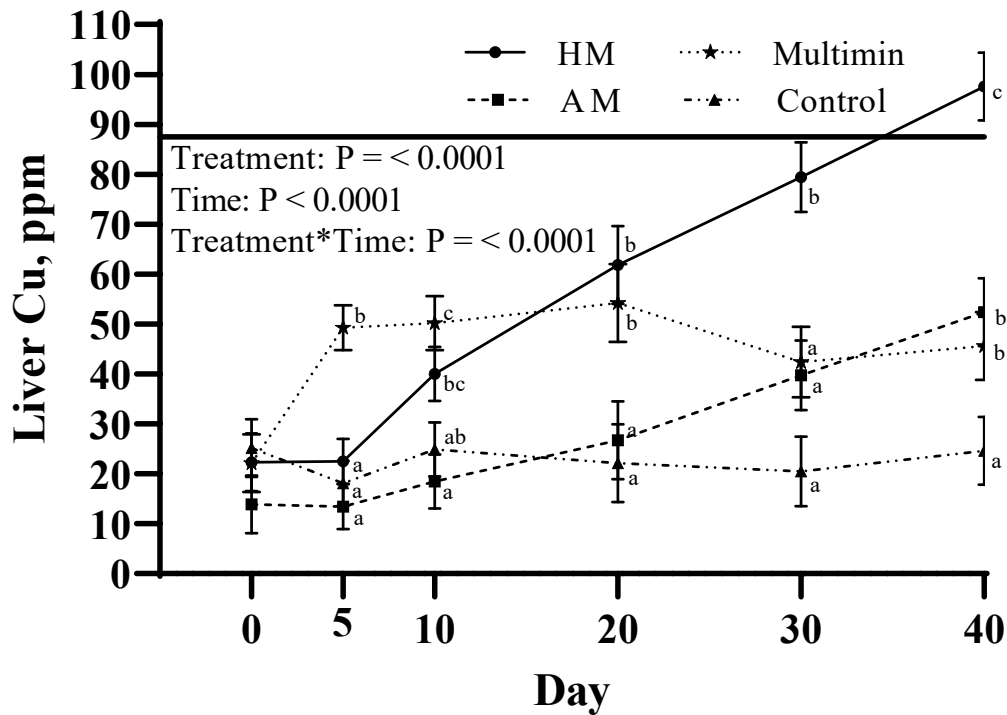


Figure 6. Mean hepatic copper (Cu) concentrations of finishing steers receiving a diet containing oral supplementation of minerals provided at levels similar to NRC requirements (AM; n = 10), oral supplementation of minerals provided at levels above NRC requirements (HM; n = 10), a MultiMin® injection at labeled dose (MM; n = 10) or no mineral supplementation (CON; n = 10) for the first 40 d of the trial. Any value below the bold black line is indicative of a clinical deficiency. Values are represented as least squares mean \pm SEM. P-values of repeated measure analysis for the fixed effects of treatment, time and their interaction are indicated in the top left corner of the graph. Time points with different letters indicate a difference ($P < 0.05$) between the different treatments at that specific time point.

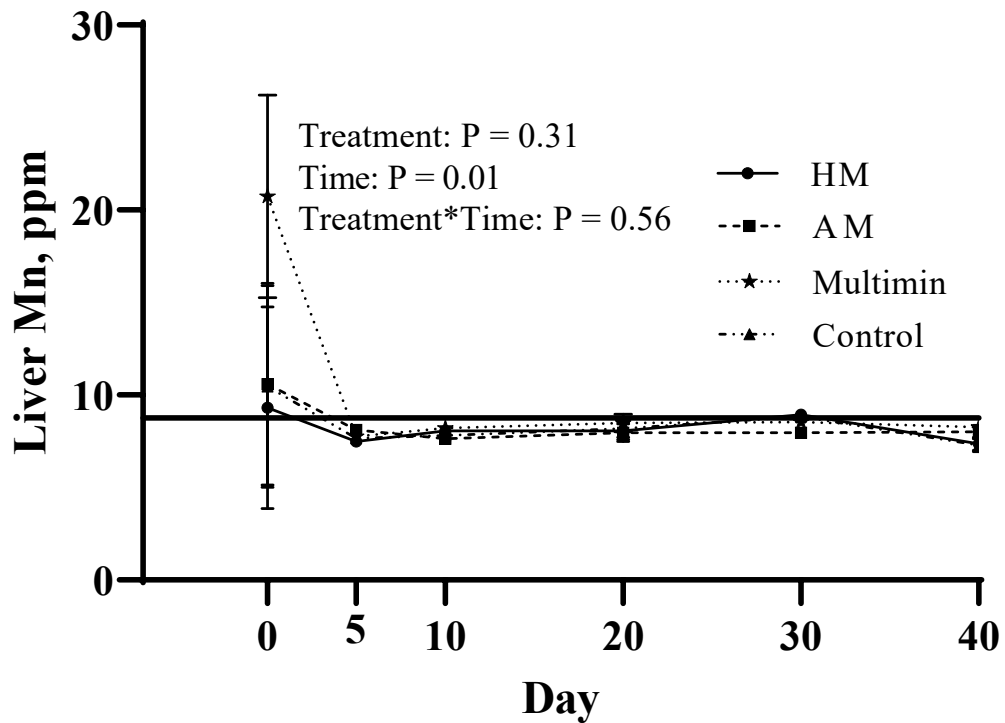


Figure 7. Mean hepatic manganese (Mn) concentrations of finishing steers receiving a diet containing oral supplementation of minerals provided at levels similar to NRC requirements (AM; n = 10), oral supplementation of minerals provided at levels above NRC requirements (HM; n = 10), a MultiMin® injection at labeled dose (MM; n = 10) or no mineral supplementation (CON; n = 10) for the first 40 d of the trial. Any value below the bold black line is indicative of a clinical deficiency. Values are represented as least squares mean \pm SEM. P-values of repeated measure analysis for the fixed effects of treatment, time and their interaction are indicated in the top left corner of the graph.

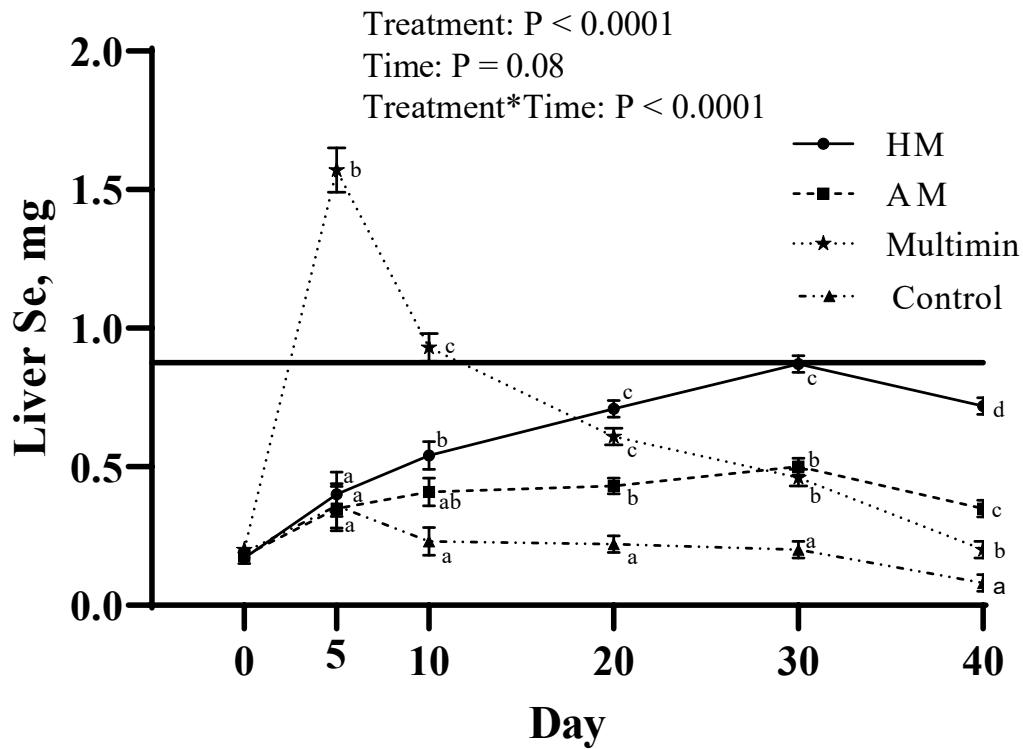


Figure 8. Mean hepatic selenium (Se) concentrations of finishing steers receiving a diet containing oral supplementation of minerals provided at levels similar to NRC requirements (AM; $n = 10$), oral supplementation of minerals provided at levels above NRC requirements (HM; $n = 10$), a MultiMin® injection at labeled dose (MM; $n = 10$) or no mineral supplementation (CON; $n = 10$) for the first 40 d of the trial. Any value below the bold black line is indicative of a clinical deficiency. Values are represented as least squares mean \pm SEM. P-values of repeated measure analysis for the fixed effects of treatment, time and their interaction are indicated in the top left corner of the graph. Time points with different letters indicate a difference ($P < 0.05$) between the different treatments at that specific time point.

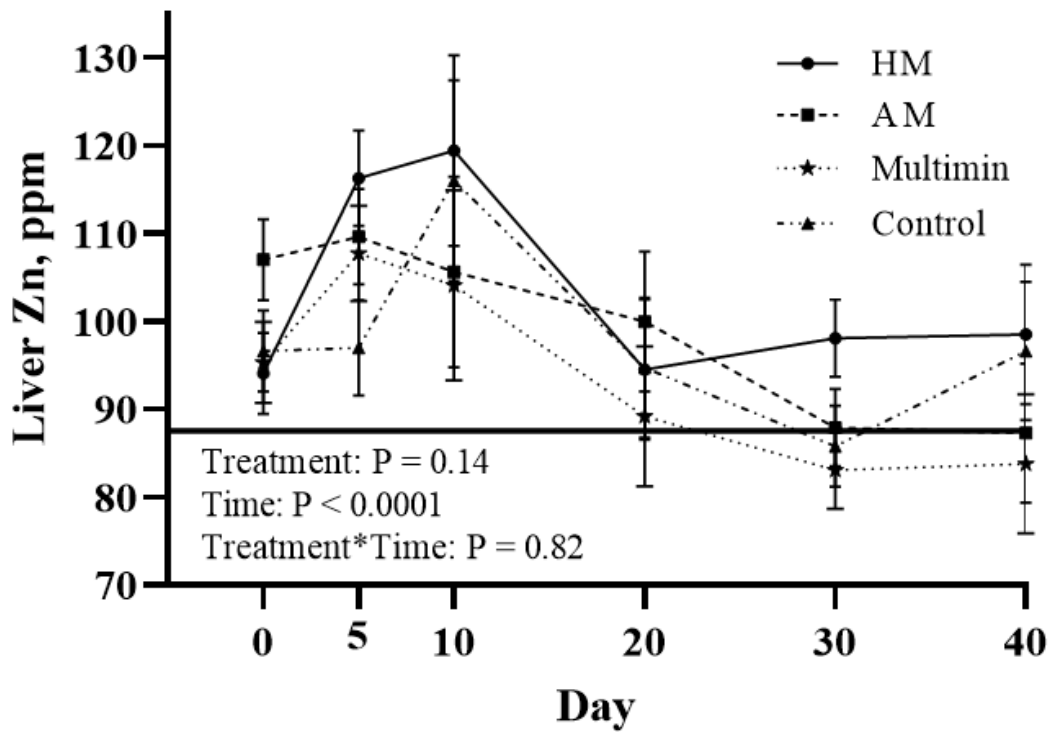


Figure 9. Mean hepatic zinc (Zn) concentrations of finishing steers receiving a diet containing oral supplementation of minerals provided at levels similar to NRC requirements (AM; n = 10), oral supplementation of minerals provided at levels above NRC requirements (HM; n = 10), a MultiMin® injection at labeled dose (MM; n = 10) or no mineral supplementation (CON; n = 10) for the first 40 d of the trial. Any value below the bold black line is indicative of a clinical deficiency. Values are represented as least squares mean \pm SEM. P-values of repeated measure analysis for the fixed effects of treatment, time and their interaction are indicated in the bottom left corner of the graph.

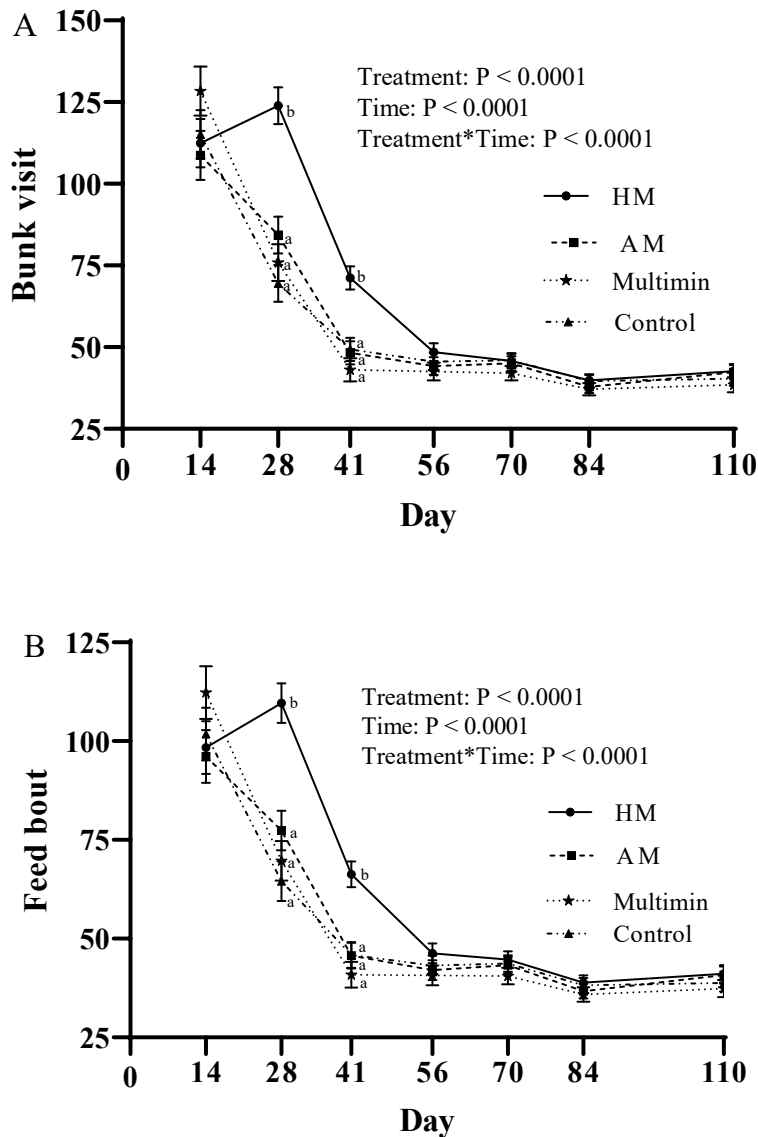


Figure 10. Average time each animal went up to the bunk defined as mean bunk visit (reading of a single animal eid tag when entering at a bunk whether it consumed feed or not, A) and feed bout (reading of a single animal eid tag when entering a bunk and consumed at least 10 g of feed, B) over 110 d finishing period in steers receiving a diet containing oral supplementation of minerals provided at levels similar to NRC requirements (AM; $n = 10$), oral supplementation of minerals provided at levels above NRC requirements (HM; $n = 10$), a MultiMin® injection at labeled dose (MM; $n = 10$) or no mineral supplementation (CON; $n = 10$) for the first 40 d of the trial. Values are represented as least squares mean \pm SEM. P-values of repeated measure analysis for the fixed effects of treatment, time and their interaction are indicated in the top right corner of the graph. Time points with different letters indicate a difference ($P < 0.05$) between the different treatments at that specific time point.

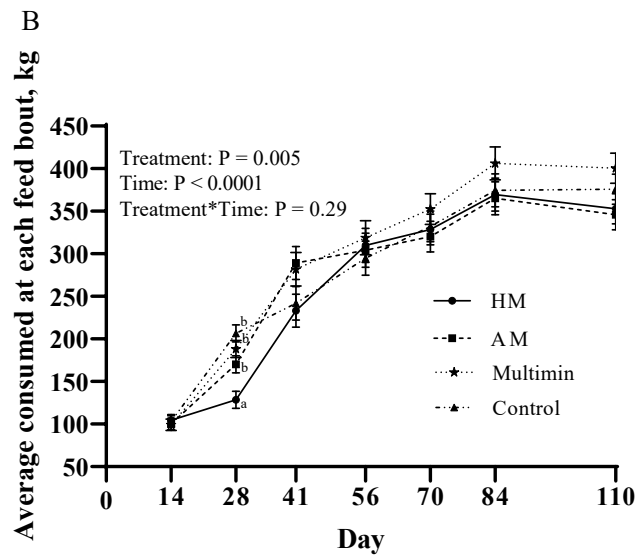
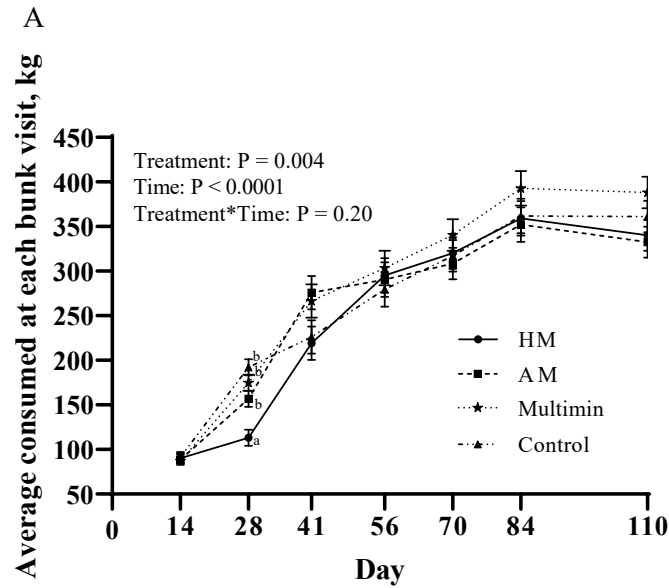


Figure 11. Average amount consumed each time the animal goes to the bunk measured as mean consumption per bunk visit (each time an animal went up to the bunk, A) and consumption per feed bout (when an animal entered a bunk and consumed at least 10 g of feed, B) over 110 d finishing period in steers receiving a diet containing oral supplementation of minerals provided at levels similar to NRC requirements (AM; $n = 10$), oral supplementation of minerals provided at levels above NRC requirements (HM; $n = 10$), a MultiMin® injection at labeled dose (MM; $n = 10$) or no mineral supplementation (CON; $n = 10$) for the first 40 d of the trial. Values are represented as least squares mean \pm SEM. P-values of repeated measure analysis for the fixed effects of treatment, time and their interaction are indicated in the top left corner of the graph. Time points with different letters indicate a difference ($P < 0.05$) between the different treatments at that specific time point.

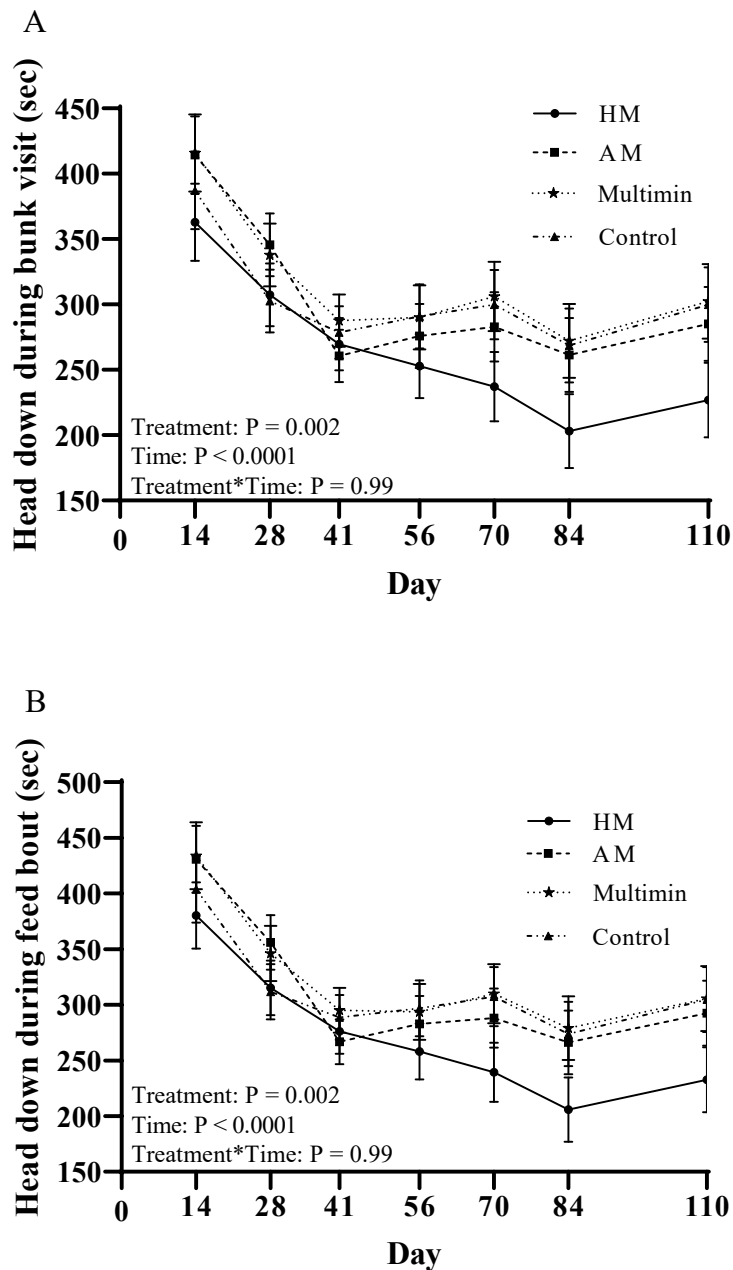


Figure 12. Mean time spent with head down per bunk visit (each time an animal went up to the bunk, A) and time spent with head down per feed bout (when an animal entered a bunk and consumed at least 10 g of feed, B) over 110 d finishing period in steers receiving a diet containing oral supplementation of minerals provided at levels similar to NRC requirements (AM; n = 10), oral supplementation of minerals provided at levels above NRC requirements (HM; n = 10), a MultiMin® injection at labeled dose (MM; n = 10) or no mineral supplementation (CON; n = 10) for the first 40 d of the trial. Values are represented as least squares mean \pm SEM. P-values of repeated measure analysis for the fixed effects of treatment, time and their interaction are indicated in the bottom left of the graph.

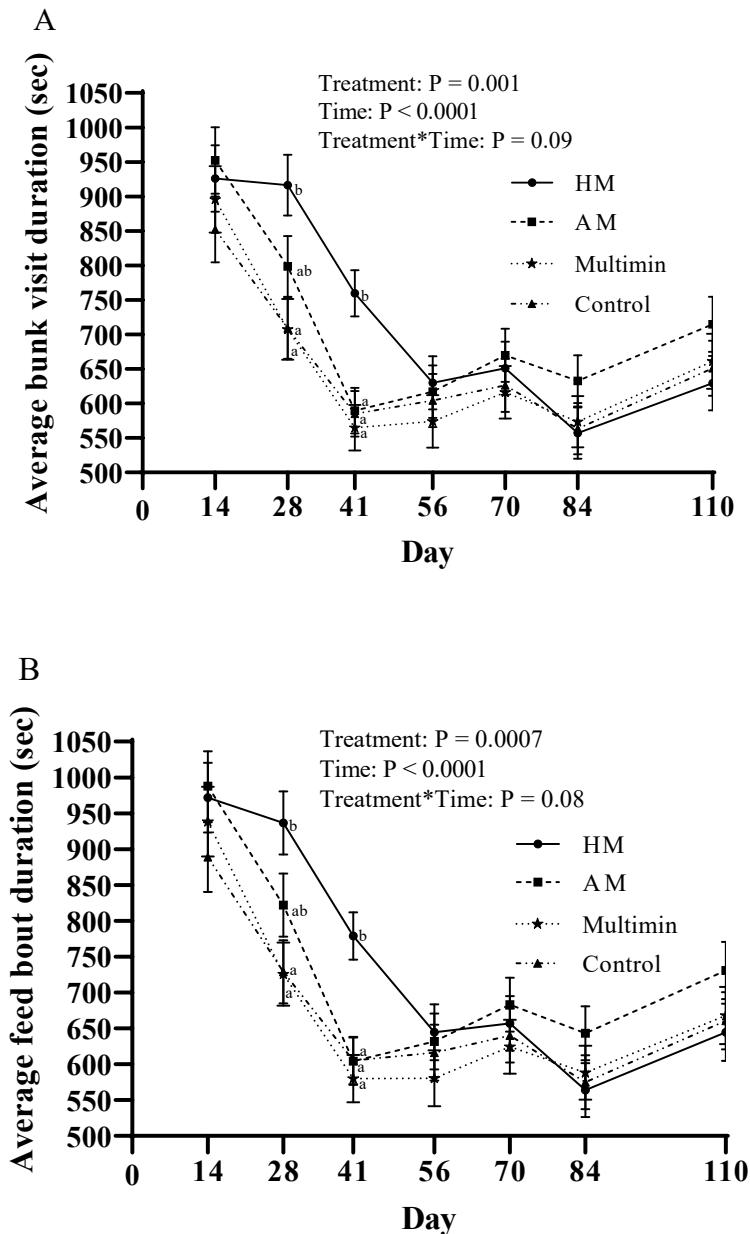


Figure 13. Mean bunk visit duration (each time an animal went up to the bunk, A) (when an animal entered a bunk and consumed at least 10 g of feed, B) over 110 d finishing period in steers receiving a diet containing oral supplementation of minerals provided at levels similar to NRC requirements (AM; n = 10), oral supplementation of minerals provided at levels above NRC requirements (HM; n = 10), a MultiMin® injection at labeled dose (MM; n = 10) or no mineral supplementation (CON; n = 10) for the first 40 d of the trial. Values are represented as least squares mean ± SEM. P-values of repeated measure analysis for the fixed effects of treatment, time and their interaction are indicated in the top middle of the graph. Time points with different letters indicate a difference.

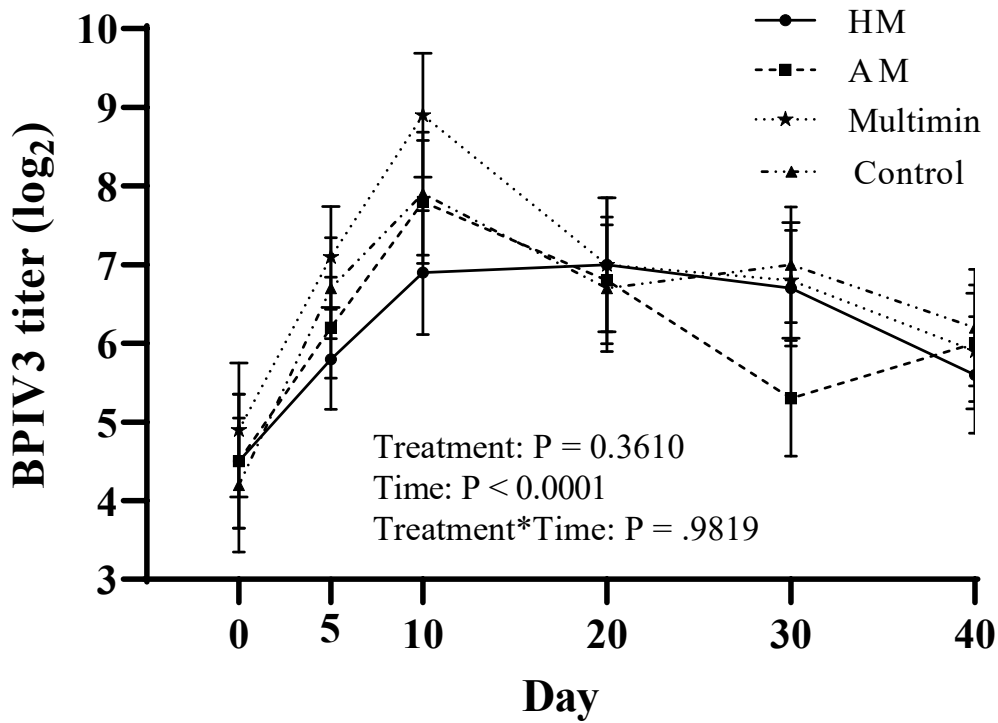


Figure 14. Average antibody titers for BPIV3 of finishing steers receiving a diet containing oral supplementation of minerals provided at levels similar to NRC requirements (AM; n = 10), oral supplementation of minerals provided at levels above NRC requirements (HM; n = 10), a MultiMin® injection at labeled dose (MM; n = 10) or no mineral supplementation (CON; n = 10) for the first 40 d of the trial. Values are represented as least squares mean ± SEM. P-values of repeated measure analysis for the fixed effects of treatment, time and their interaction are indicated in the top left corner of the graph.

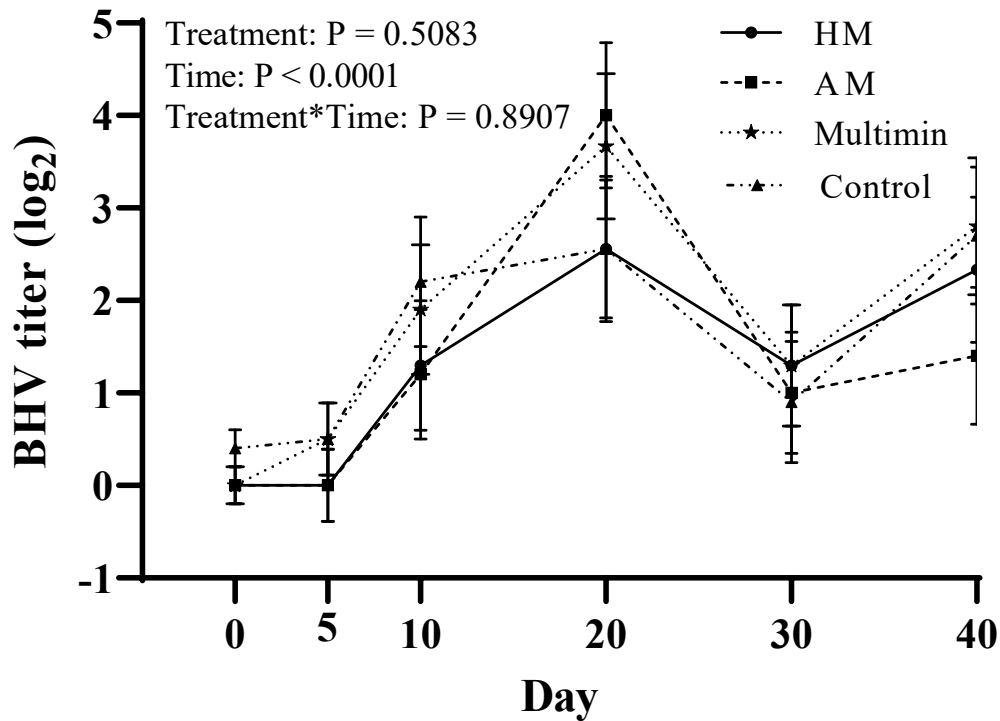


Figure 15. Average antibody titers for BHV of finishing steers receiving a diet containing oral supplementation of minerals provided at levels similar to NRC requirements (AM; n = 10), oral supplementation of minerals provided at levels above NRC requirements (HM; n = 10), a MultiMin® injection at labeled dose (MM; n = 10) or no mineral supplementation (CON; n = 10) for the first 40 d of the trial. Values are represented as least squares mean \pm SEM. P-values of repeated measure analysis for the fixed effects of treatment, time and their interaction are indicated in the top left corner of the graph.