PURINA

REVIEW >

< RESEARCH

Are Chelated and Organic Trace Minerals Required in Equine Diets to Increase Nutrient Digestibility?

A SUMMARY OF RESEARCH CONDUCTED BY PURINA ANIMAL NUTRITION, EXAMINING THE EFFECTS OF CHELATED AND ORGANIC COPPER, ZINC, MANGANESE AND COBALT, ALONG WITH ORGANIC SELENIUM YEAST ON NUTRIENT DIGESTIBILITY IN HORSES.[1-4]

< INTRODUCTION >

Minerals can be provided in equine diets in many different forms. Most are naturally occurring in feedstuffs, but minerals are also added to diets to ensure horses are getting adequate amounts and proper ratios of minerals, appropriate for the individual horses' activity level, age and pregnancy status. In recent years, the use of organic and chelated minerals has garnered much attention and use, with some benefits shown in livestock species. However, the research in horses is less clear. The National Research Council's *Nutrient Requirements of Horses* cites a variety of studies utilizing different mineral sources, but the results at best are unclear.[5] To that end, Purina continues to conduct research looking at minerals from a variety of sources and their effects on horse performance. In this trial, we specifically evaluated the effects of adding organic, chelated copper, zinc, manganese, cobalt and an organic selenium yeast to an equine feed on the digestibility of these minerals. The objective of this study was to test the hypothesis that feed additives such as chelated minerals and organic selenium would improve nutrient digestibility when included in an equine diet.

< MATERIALS AND METHODS >

Ten American Quarter Horse geldings (4.5-16 yr of age; mean BW 522 kg ± 46 kg) were utilized in a randomized crossover design, including two treatment groups. The groups were: 100% pelleted diets formulated with organic/chelated mineral additives (ADD) for copper, zinc, manganese, cobalt and selenium yeast; 100% pelleted diet formulated with copper sulfate, zinc sulfate, manganese sulfate, cobalt sulfate and sodium selenite (CTRL). All diets met or exceeded NRC nutrient requirements for a horse at average maintenance. The base pelleted feed was Purina® Horse Chow® feed. Horses were transitioned and acclimated to each treatment over 49 days, followed by full fecal and urine collection for 14 days utilizing specially designed collection harnesses. A 49 day washout period was employed before horses crossed over to the opposite treatment. All horses were acclimated to digestibility

[1]ME Gordon, MS Edwards, CR Sweeney, ML Jerina. 2013. Effects of added chelated trace minerals, organic selenium, yeast culture, direct-fed microbials and Yucca schidigera extract in horses. Part I: Blood nutrient concentration and digestibility. *Journal of Animal Science* 91(8):3899-908.

[2]ME Gordon, MS Edwards, CR Sweeney, ML Jerina. 2013. Effects of added chelated trace minerals, organic selenium, yeast culture, direct-fed microbials and Yucca schidigera extract in horses. Part II: Stock-piled manure characteristics. *Journal of Animal Science* 91(8):3909-3016.

[3]MS Edwards, ME Gordon. 2013. Replacement of cool season grass hay with pelleted feeds consumed by Quarter Horse geldings Part I: Digestibility. *Journal of Equine Veterinary Science* 33(5); 367.

[4]MS Edwards, ME Gordon. 2013. Replacement of cool season grass hay with pelleted feeds consumed by Quarter Horse geldings Part II: Impact on stockpiled manure characteristics. *Journal of Equine Veterinary Science* 33(5); 367-368.

[5]National Research Council. 2007. *Nutrient Requirements of Horses*, 6th revised edition. The National Academies Press.

harnesses prior to the study to facilitate total collection of feces and/or urine. Total daily diet quantities were offered at 2.0% BW, with amounts adjusted weekly based upon body weight data. During the collection periods, total fecal mass was quantified twice daily and subsamples retained from each collection for later analysis. Samples were dried, ground and subsampled from d 1, 8 and 15 for analyses of dry matter (DM), acid detergent fiber (ADF) and neutral detergent fiber (NDF) by Dairy One Forage Lab using wet chemistry. Apparent nutrient digestibility (%) was calculated as: 100 x (nutrient intake – fecal nutrient excretion) / nutrient intake. Blood samples were collected once weekly during the acclimation and collection periods. Serum samples were collected for Cu, Zn, Mn and Co analyses and whole blood samples for Se analyses. Samples were submitted to Michigan State University's Diagnostic Center for Population and Animal Health (Lansing, MI) for mineral analyses using a modified ICP-MS method. For statistical investigation of results, analysis of variance was performed with mixed models (SAS 9.2 2010), and least squares means compared with Fisher's least significant difference ($P < 0.05$).

< RESULTS >

There were no differences in apparent digestibility for Cu ($P = 0.7238$), Zn ($P = 0.2564$), Mn ($P = 0.8878$), Co ($P = 0.7097$) or Se ($P = 0.5877$) between the ADD and CTRL groups (Figure 1). No differences were observed in serum Cu, Mn or Co concentrations between ADD and CTRL at acclimation or collection time points ($P > 0.05$, Figures 2,4,5). While no difference in serum Zn concentrations were observed between ADD and CTRL groups at acclimation ($P > 0.05$), they were statistically higher at the collection time period for horses consuming CTRL ($P < 0.0001$, Figure 3). Whole blood Se concentration was higher in the CTRL group versus the ADD group both at acclimation ($P = 0.0407$) and collection ($P = 0.0054$) time periods (Figure 6). In reference to time, serum Cu concentrations increased ($P = 0.0115$) for animals consuming CTRL but not ADD ($P > 0.05$, Figure 2). Serum Zn concentrations of horses consuming both ADD ($P = 0.0211$) and CTRL ($P < 0.0001$) increased over time from acclimation to collection time points (Figure 3). No time differences ($P > 0.05$) were observed in serum Mn concentrations (Figure 4). Serum Co concentrations increased over time in horses consuming both ADD ($P = 0.0012$) and CTRL ($P = 0.0212$, Figure 5). From acclimation to collection, whole blood Se concentration increased for horses consuming CTRL ($P = 0.0095$) but not for ADD ($P > 0.05$, Figure 6).

< IMPLICATIONS >

The results of this study indicate no effect on nutrient digestibility due to the inclusion of chelated minerals or organic selenium for horses at maintenance. Although the addition of certain types of minerals may be beneficial to horses under specific conditions, adding traditional forms of minerals such as sulfate forms leads to optimal mineral status. Bloodwork analyzed in this study showed adequate mineral levels from traditional forms of copper, zinc, manganese, cobalt and selenium. When healthy horses at maintenance are fed readily digestible concentrate feeds with appropriate levels of added minerals, chelated and organic sources of those minerals may have limited benefit. The inclusion of chelated and organic minerals in equine diets should be accompanied by quality research, demonstrating efficacy and measurable benefit to the horse.

FIGURE 1 Mean apparent digestibility did not differ for Cu, Zn, Mn, Co or Se ($P > 0.05$).

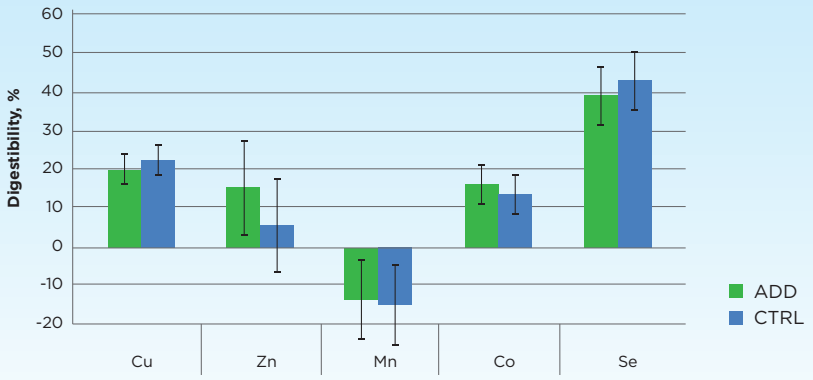


FIGURE 2

Significant differences between serum Cu concentrations by treatment at each time point (Panel A) and by time within treatment (Panel B) are denoted by differing superscripts ($^{x,y}P = 0.0115$). Lack of superscripts denotes $P > 0.05$.

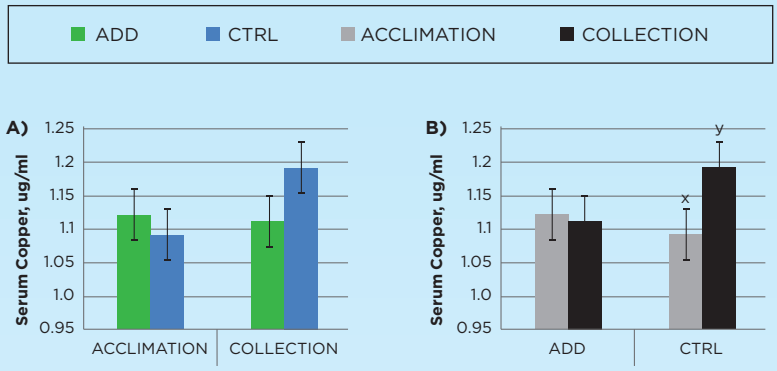


FIGURE 3

Significant differences between serum Zn concentrations by treatment at each time point (Panel A; $^{c,d}P < 0.0001$) and by time within treatment (Panel B; $^{p,q}P = 0.0211$; $^{x,y}P < 0.0001$) are denoted by differing superscripts. Lack of superscripts denotes $P > 0.05$.

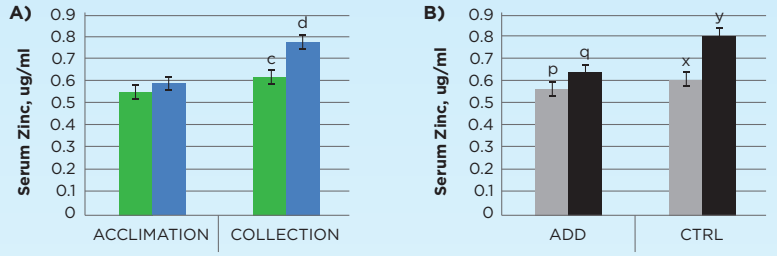


FIGURE 4

Serum Mn concentrations by treatment at each time point (Panel A) and by time within treatment (Panel B) did not differ ($P > 0.05$).

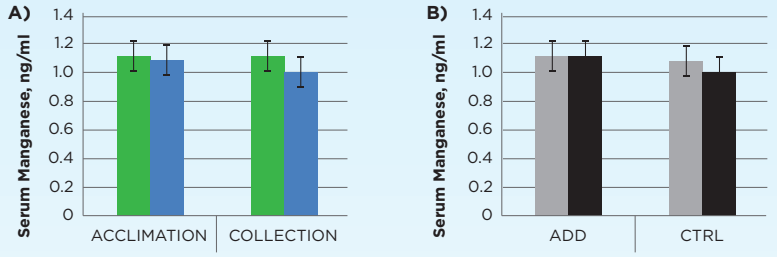


FIGURE 5

Significant differences between mean serum Co concentrations by treatment within each time point (Panel A) and by time within treatment (Panel B; $^{p,q}P = 0.0012$; $^{x,y}P = 0.0212$) are denoted by differing superscripts. Lack of superscripts denotes $P > 0.05$.

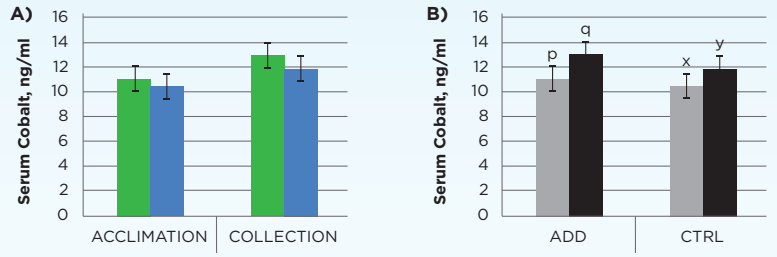
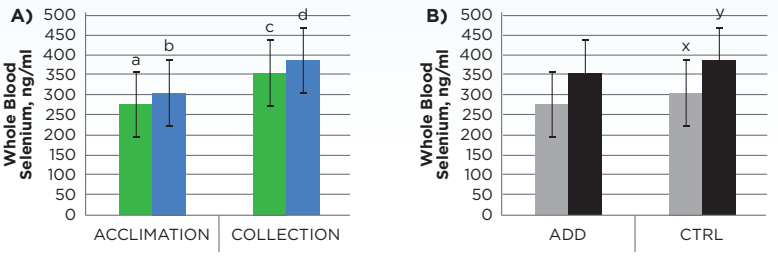


FIGURE 6

Significant differences between mean whole blood Se concentrations by treatment within each time point (Panel A; $^{a,b}P = 0.0407$; $^{c,d}P = 0.0054$) and by time within treatment (Panel B; $^{x,y}P = 0.0095$) are denoted by differing superscripts. Lack of superscripts denotes $P > 0.05$.



< FOR MORE INFORMATION > Contact your local Purina representative if you would like more information about this study.

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