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TECHNICAL INFORMATION FOR TODAY'S FEED PROFESSIONAL

Effects of Trace Mineral Source on Preweaned Calf Performance

Introduction

Trace minerals are required for normal metabolic processes, growth, and immune function in calves. Calf diets (milk replacer, calf starter) typically contain trace minerals that are bound to inorganic molecules (e.g., sulfate, chloride). However, trace minerals bound to organic molecules (e.g., amino acids, proteinate, propionate) have been shown to have greater bioavailability and/or tissue retention versus inorganic forms. Greater trace mineral bioavailability may support improved immune function during times of stress as well as faster growth rates.

Functions of Trace Minerals in Young Calves

Organic trace minerals that are commonly used in calf milk replacers are zinc (Zn), manganese (Mn), iron (Fe), copper (Cu), cobalt (Co), and selenium (Se). Organic selenium is commonly included in milk replacers due to its importance for immune and antioxidant function, as well as its relatively low cost. The impact of organic Zn, Mn, Fe, and Cu has been the focus of recent research, and the biological functions and common supplemental forms of these minerals are detailed in **Table 1** below.

Table 1. Functions and common supplemental forms of zinc, manganese, iron, and copper for young calves

Minerals	Functions	Common Inorganic Form	Common Organic Form
Zinc	Disease resistance, muscle development, appetite, skin and claw health, hair coat	Zinc sulfate	Zinc methionine complex[1]
Manganese	Disease resistance, bone development, skin and claw health	Manganese sulfate	Manganese methionine complex[1]
Iron	Disease resistance, oxygen transport	Ferrous sulfate	Iron amino acid complex[1]
Copper	Disease resistance, bone development, appetite, skin and claw health, nervous system, hair coat, oxygen transport	Copper sulfate	Copper lysine complex[1]

[1]Zinpro Performance Minerals®, Eden Prairie, MN

Research Support – Organic Trace Mineral Supplementation of Preweaned Calves

Conventional plane of nutrition: Golombeski et al. (2008) conducted research at University of Minnesota Southern Research and Outreach Center (Waseca, MN) with Holstein heifer calves sourced from three commercial dairies. Treatments were: 1) 20-20 all-milk milk replacer (MR) with 100% inorganic trace minerals **(control)**, 2) 20-20 all-milk MR with 100% organic Zn, Mn, Fe, and Cu **(Org TM)**, and 3) 20-20 all-milk MR with 100% organic Zn, Mn, Fe, Cu, and Se **(Org TM + Org Se)**. Calves were fed MR powder at a rate of 1.25 lbs/day from day 1-35, then 0.625 lbs/day from d 36-42 then weaned. Calves were fed an 18% CP texturized starter, and were housed in individual pens from d 1-56. Organic trace mineral supplementation did not affect average daily gain (ADG), feed efficiency, or health parameters; however, calves on the Org TM treatment had significantly greater hip height gains from day 1 to 56 compared with the control treatment (4.32 vs. 3.80 inches, respectively). The calves in this study were fed colostrum, raised in a well-managed facility with low pathogen load, and fed a conventional nutrition program; therefore, results may have been affected by the low degree of immune stress and conventional plane of nutrition. Organic trace minerals could be a low-cost and effective addition to milk replacers fed to dairy beef calves due to the calf's unknown colostrum status and the increased likelihood that dairy beef calves experience greater stress (e.g., transport, pathogen exposure, etc.).

Accelerated plane of nutrition: A study at the University of Illinois (Osorio et al., 2008) tested the effects of plane of nutrition (conventional vs. accelerated) and trace mineral form (inorganic vs. organic) on growth of transported Holstein bull calves. Organic trace minerals were sourced from Zinpro Performance Minerals® **(ZPM)**. The four treatments were conventional nutrition + inorganic trace minerals **(CI)**, conventional nutrition + organic trace minerals **(CZPM)**, accelerated nutrition + inorganic trace minerals **(AI)**, and accelerated nutrition + organic trace minerals **(AZPM)**. Conventionally fed calves were fed a 22-20 MR at 1.25 lbs/day, had free-choice access to an 18% CP starter, and were weaned at 6 weeks of age. The accelerated program employed a 28-20 MR fed at 1.25 lbs/day for week 1, 1.78 lbs/day for week 2, 2.50 lbs/day for week 3-6, and 1.25 lbs/day for week 7 (weaning), plus a 22% CP starter. For the CZPM and AZPM treatments, both the MR and the calf starter contained organic sources of Zn, Mn, Fe, and Cu.

Results indicated that there was an interaction of trace mineral source and plane of nutrition, meaning that organic trace minerals improved growth of calves on the accelerated plane of nutrition but did not affect growth of conventionally fed calves. **Figure 1** shows that AZPM calves had greater ADG from week 1 to 9 compared with the other treatments (plane of nutrition × trace mineral source interaction, $P \leq 0.05$).

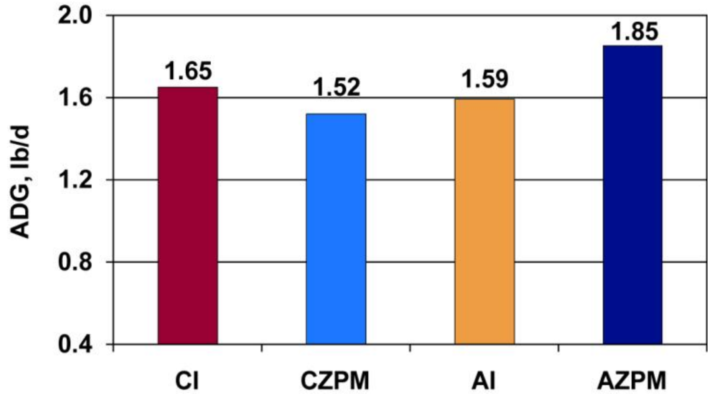

Figure 1. Effect of plane of nutrition and trace mineral source on week 1-9 average daily gain (Osorio et al., 2008).
[z] Plane of nutrition × trace mineral source interaction, $P \leq 0.05$

Similarly, a plane of nutrition × trace mineral source interaction existed for frame growth where AZPM calves had greater hip height at week 5 ($P < 0.05$), week 8 ($P < 0.05$), and week 12 ($P = 0.08$); data is shown in **Figure 2**.

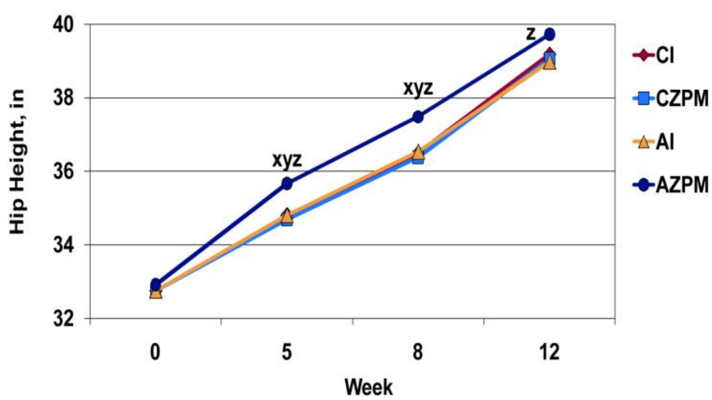

Figure 2. Effect of plane of nutrition and trace mineral source on hip height (Osorio et al., 2008).
[x] ZPM vs. inorganic; $P \leq 0.05$, wk 5; $P = 0.063$, wk 8
[y] Plane of nutrition, $P \leq 0.05$
[z] Plane of nutrition × trace mineral source interaction; $P < 0.05$, wk 5 and 8; $P = 0.078$, wk 12

Data shown here indicates that organic trace minerals can support greater gain and frame growth when provided as part of an accelerated, or intensive, growth program. Intensive feeding programs are designed to allow calves to achieve superior frame and lean tissue growth compared with conventional programs. While trace mineral concentration is important, data presented here illustrates that trace mineral bioavailability is integral in allowing the intensively fed calf to achieve her growth potential.

Summary

- Trace minerals are essential to important functions related to calf growth and health
- Organic trace minerals typically have greater bioavailability than do inorganic trace minerals
- Research data indicates that organic trace minerals improve gain and frame growth in calves fed an intensified plane of nutrition but not in calves fed a conventional milk replacer program.

References

Golombeski et al. 2008. Pre-and post weaning performance and health of calves fed milk replacers supplemented with trace minerals from differing sources. J. Dairy Sci. 91(Suppl. 1):466. Abstr.

Osorio et al. 2008. Effects of plane of nutrition and bioavailable trace minerals on growth of transported male dairy calves. J. Dairy Sci. 91(Suppl. 1):562. Abstr.