BEEF CATTLE RESEARCH UPDATE

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Effects of Trace Mineral Source on Bull and Heifer Development

Research has generally shown that organic trace minerals are more bioavailable than inorganic minerals. It is well documented that trace mineral supplementation has an impact on reproductive performance. A number of recent studies suggest that feeding organic sources of trace minerals to developing bulls and heifers may be beneficial.

University of Florida researchers evaluated the effect of post-weaning trace mineral source on bull growth, performance and liver trace mineral status, and sexual development over a 224 day period.[1,2] In this study, bulls averaging 231 days of age and 573 lb were developed on a ration including cracked corn, cottonseed hulls, a protein pellet, and a trace mineral supplement pellet. Trace minerals were provided in either inorganic (sulfates) or organic (selenium yeast and proteinate) forms. The bulls were weighed weekly and assessed bi-weekly for body condition score (BCS), scrotal circumference, and semen characteristics. Semen collection initiated when scrotal circumference reached 26 cm. Puberty was defined as an ejaculate with sperm concentrations ≥ 50 million per mL and ≥ 10 % motility. Sexual maturity was defined as passing a breeding soundness exam. In addition, liver biopsies were collected every 56 days to determine the trace mineral status for cobalt, copper, iron, manganese, molybdenum, selenium, and zinc.

Bull performance and liver trace mineral concentration were not affected by trace mineral source. However, liver trace mineral concentrations were affected ($P < 0.01$) by time, increasing from the start of the trial in all bulls. At puberty; age (345 vs. 343 days), body weight (814 vs. 851 lb), BCS (4.9 vs. 4.8), and scrotal circumference (29.3 vs. 29.6 cm) were similar for the inorganic and organic treatments, respectively. However, at sexual maturity, bulls developed on organic trace minerals (399 days) tended ($P = 0.10$) to be younger compared to bulls fed inorganic trace minerals (424 days), while body weight (1054 vs. 1030 lb), BCS (5.3) and scrotal circumference (33.4 vs. 31.1 cm) were similar between the inorganic and organic treatments, respectively. Sperm motility also tended ($P = 0.10$) to be greater for organic (42.5%) compared to inorganic sources of trace minerals (35%) at sexual maturity. These researchers concluded that “bull pubertal traits were not affected by trace mineral source, but source may shorten the time it takes bulls to reach sexual maturity”.

University of Arkansas researchers observed similar results in 2012, reporting that bulls supplemented with organic trace minerals (Availa®4, Zinpro Corporation) had more ($P < 0.03$) motile, progressive, and rapid sperm than those supplemented with inorganic trace (sulfate forms) minerals (65.5 vs. 56.1%, 47.0 vs. 38.4%, and 62.3 vs. 52.8%, respectively).[3] Both the Florida and Arkansas studies suggest that organic trace mineral supplementation may improve bull semen quality.

Recent University of Arkansas research used 219 crossbred heifers over a 4-year period to look at the effects of trace mineral source on beef heifer reproduction.[4] In this study, heifers were randomly assigned to 1 of 2 treatments: 1) received all supplemental mineral in inorganic forms as copper, zinc, and manganese in sulfate forms and cobalt carbonate, or 2) received the same amount of trace minerals but all or a portion of these were from organic forms as copper, zinc, and manganese amino acid complexes and Co in the form of Co glucoheptonate (Availa®4, Zinpro Corporation).

These researchers reported that heifer body weight and BCS did not differ between treatments at the time of pregnancy determination (palpation). However, supplementing heifers with a portion of organic trace mineral sources tended to increase the percentage of heifers that entered the breeding herd and improve reproductive performance as evidenced by a greater percentage of heifers

calving; and a decreased percentage of heifers culled after their first year in the cow herd (Table 1). In the subset of heifers that conceived and remained on these dietary treatments, there was a decreased (P = 0.04) percentage that were culled before their first pregnancy determination (4.8 vs. 15.7%), respectively, for organic and inorganic trace mineral sources. These researchers concluded that the feeding of organic trace minerals improved the likelihood of the heifers producing a calf.

Table 1. Effect of trace mineral source on beef heifer reproduction.

Item	Inorganic	Organic	P-value
% entering herd	70.4	87.5	0.06
% calving	66.0	76.8	0.09
% culled after 1st year in cow herd	33.7	22.1	0.07
% culled before 1st pregnancy determination	15.7	4.8	0.04

Adapted from Burnett et al., 2016.

University of Florida research (2004) showed that young cows (3 and 4 years of age) consuming organic minerals (Availa®4) had greater pregnancy rates (89 vs. 61%) and shorter calving intervals (364 vs. 380 days) compared with cows consuming inorganic trace minerals.[5] In contrast, feeding organic trace minerals to mature cows (>4 years of age) did not increase pregnancy rates (95 vs. 94%) and shorten calving intervals (358 vs. 354 days) as compared to feeding inorganic trace minerals.

In summary, all of these studies suggest that feeding organic sources of trace minerals to developing bulls and heifers may be beneficial, improving semen quality in bulls and increasing pregnancy rates and retention of young cows in the herd.

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[1] Price, D. M., K. M. Havill, S. R. Hayter, L. J. Sims, R. West, D. O. Rae, D. M. Irsik, L. J. Spicer, M. J. Hersom, and J. V. Yelich. 2016. Effect of trace mineral (TM) source on postweaning Bos Taurus bull growth, performance and liver mineral status. J. Anim. Sci. 94 (Suppl. 1): 46 (Abstr.).

[2] Price, D. M., K. M. Havill, S. R. Hayter, L. J. Sims, D. O. Rae, D. M. Irsik, L. J. Spicer, M. J. Hersom, and J. V. Yelich. 2016. Effect of trace mineral source on postweaning Bos Taurus beef bull sexual development. J. Anim. Sci. 94 (Suppl. 1): 33 (Abstr.).

[3] Rowe, M. P., J. G. Powell, E. B. Kegley, T. D. Lester, C. L. Williams, R. J. Page and R. W. Rorie. 2012. Influence of organic versus inorganic trace mineral supplementation on bull semen quality. Arkansas Animal Science Department Report Research Series 597:11-13.

[4] Burnett, R. H., E. B. Kegley, J. C. Moore, J. G. Powell, R. W. Rorie, and C. K. Larson. 2016. Comparison of Organic and Inorganic Trace Minerals Supplementation Strategies for Beef Heifers. J. Anim. Sci. 94 (Suppl. 1): 46-47 (Abstr.).

[5] Arthington, J. D. and C. K. Swenson. 2004. Effects of trace mineral source and feeding method on productivity of grazing Braford cows. The Professional Anim. Scientist 20:155-161.