



BEEF CATTLE RESEARCH UPDATE

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Effect of Supplemental Vitamin A Concentrations on Marbling in Feedlot Cattle

A recent review of research evaluating the potential effects of vitamins A and D on marbling deposition in beef cattle suggested that steers consuming diets low in vitamin A concentration exhibited less serum retinol and produced greater marbling scores compared with steers consuming high vitamin A diets.¹ The 2000 Beef NRC recommends a dietary vitamin A concentration of 1,000 IU/lb of dry matter for feedlot cattle. A survey of feedlot consulting nutritionists in 2000 showed the average vitamin A level in receiving and finishing diets to be 3,660 and 2,070 IU/lb, respectively.² A 2007 survey of feedlot consulting nutritionists showed the average vitamin A concentration recommended by consultants was 2,370 IU/lb in finishing diets (range of 1,002 to 5,010 IU/lb).³

Recent Ohio State University research evaluated the effect of dietary vitamin A concentration on marbling in beef steers.⁴ In this research, Angus crossbred steers (initial weight of 649 lb) were fed high-moisture corn based finishing diets for 168 days with no supplemental vitamin A or 1,227 IU/lb of supplemental vitamin A. In this study, low vitamin A diets did not effect feedlot performance. However, marbling scores and the percentage of carcasses grading low choice or greater tended to be greater with no supplemental vitamin A. In contrast, dietary vitamin A level had no effect on backfat thickness or USDA yield grade.

In additional Ohio State University research, Holstein steers (initial weight of 480 lb) were fed high-moisture corn based diets with 1,000 IU/lb of supplemental vitamin A (control diet) or no supplemental vitamin A for a long (243 days) or short restriction (131 days) before slaughter at 243 days on feed.⁵ Similar to the previous Ohio research, feedlot performance was not affected by vitamin A restriction. On day 243, the intramuscular fat content (marbling) was 33% greater for steers not fed supplemental vitamin A for the entire feeding period compared with short restricted and control steers (5.6 vs 3.8 and 4.2% ether extract, respectively). Backfat thickness and visceral fat deposition (KPH) were not affected by vitamin A restriction. Restricting vitamin A intake for 131 days at the end of the finishing period appeared to be insufficient to affect site of fat deposition in these Holstein steers.

University of Illinois research evaluated the effect of vitamin A on marbling in Angus x Simmental cattle.⁶ Diets (whole shelled corn based) containing either 1,045 or 3,295 IU/lb of supplemental vitamin A were fed in three experiments. In experiment 1, early weaned heifers were fed the two vitamin A levels for the last 163 days of a 332 day growing/finishing period. For the first 169 days, all heifers were fed a diet containing 445 IU/lb. Heifers fed the low level of vitamin A tended to have greater marbling deposition. In experiment 2, yearling steers (818 lb) were fed the two dietary vitamin A levels for 105 days. No treatment differences were noted. In experiment 3, early weaned steers were fed the two vitamin A levels for 280 days. Dietary vitamin A level did not affect marbling deposition.

Colorado research has also evaluated the effect of dietary supplemental vitamin A concentration on the performance and carcass traits of yearling feedlot steers.⁷ Steers (initial weight of 695 lb) were fed a 91% concentrate diet (steam-flaked corn based) for a 142 day finishing period. Five concentrations of supplemental vitamin A were tested (0, 501, 1002, 2005, or 4009 IU/lb of dry matter). Dietary vitamin A concentration had no affect on performance or any carcass traits.

In summary, some research suggests that feeding no supplemental vitamin A to feedlot cattle might increase marbling deposition. The length of time for which no vitamin A is fed may be important. The Ohio research suggested that feeding no vitamin supplemental A for the last 131 days of a finishing period was insufficient to affect marbling deposition in Holstein steers. Feeding supplemental vitamin A at levels of up to four times the NRC suggested concentration (1000 IU/lb) appears to have little effect on performance or marbling in feedlot cattle. The nutritional and management history or background of cattle prior to entering the feedlot could also affect the response to vitamin A supplementation since surplus levels of vitamin A can be stored in liver reserves for later distribution. Research from 1970 suggested that yearling cattle entering the feedlot with medium vitamin A liver reserves (20 to 40 µg/g) from natural feeds consumed previously or by injection, need little or no vitamin A for periods of 90 to 120 days.⁸

Effects of Diet for Early-Weaned Beef Steers on Immune Response

Factors such as rising production cost and drought have led to more beef producers early weaning their calves. These calves can be backgrounded on forage or placed directly on feed. Determining the appropriate level of protein supplementation with cattle backgrounded on forage is of interest since protein is frequently the most limiting nutrient in low-quality forages. The effects of protein supplementation of low-quality forage (fed during a backgrounding phase) on the immune response during a feedlot receiving period are unknown. University of Arizona researchers recently used early weaned crossbred beef steers (average of 132 days old and 233 lbs) to evaluate the effect of protein supplementation of forage diets versus feeding a 70% concentrate diet during a backgrounding phase on the metabolic profile and febrile response (fever) to an infectious bovine herpesvirus-1 (BHV-1) challenge during a receiving phase.⁹ During an 84 day backgrounding phase, the calves were individually fed bermudagrass hay alone (6.7% crude protein, DM basis), hay plus soybean meal fed at either 0.175 or 0.35% of body weight (as fed basis), or fed a 70% concentrate diet (13% crude protein, DM basis). After the backgrounding phase, all calves were individually fed the concentrate diet during a 27 day feedlot receiving phase. Steers previously fed forage were transitioned to the concentrate diet over a 3 day period. At the start of the receiving phase (day 85), the calves were challenged intranasally with an infectious dose of BHV-1.

As expected, steers fed the concentrate diet had greater gains, gain to feed ratios, and intakes than the average of the forage fed steers (with and without protein supplementation) throughout the entire backgrounding phase. In addition, feeding supplemental protein increased daily gain and efficiency (gain/feed) during days 28 to 56 and days 56 to 84 compared to cattle fed forage only. Hay intake and total intake was increased during day 56 to 84 with protein supplementation. Feeding the higher level of soybean meal did not increase performance above that obtained with the low level. The low level of soybean meal supplementation met protein requirements recommended by the Beef NRC. In this trial, increasing crude protein above NRC requirements was not beneficial.

Research has shown that protein supplementation generally increases circulating urea nitrogen concentrations. In this study, the serum urea nitrogen concentration (SUN) of steers supplemented with soybean meal was greater than that of non-supplemented steers on days 28 and 85. Increasing the level of soybean supplementation from 0.175 to 0.35% of body weight also resulted in greater SUN on days 28 and 85.

Rectal temperatures 3 and 4 days after the BHV-1 respiratory challenge were about 0.75°C greater for protein supplemented steers than the non-supplemented steers. Research has shown that fever generally benefits the animal since the severity of some viral infections is decreased and immune responses become more effective at elevated temperatures.

In conclusion, these researchers concluded that feeding a higher quality diet during a backgrounding period enhances the performance of early weaned steers and increases the febrile response (as measured by rectal temperature) to an infectious herpesvirus-1 respiratory challenge. They further suggest that early weaned steers backgrounded on low quality forage be supplemented with crude

protein according to NRC requirements. Feeding diets with less crude protein than NRC requirements may compromise performance. However, feeding more crude protein than is recommended by the NRC may not be beneficial.

- ¹ Pyatt, N. A. and L. L. Berger. 2005. Review: Potential effects of vitamins A and D on marbling deposition in beef cattle. *Prof. Anim. Sci.* 21:174-181.
- ² Galyean, M. L. and J. F. Gleghorn. 2002. Summary of the 2000 Texas Tech University consulting nutritionist survey. Plains Nutrition Council Spring Conference Pub. No. AREC 02-20:1-10.
- ³ Vasconcelos, J. T. and M. L. Galyean. 2007. Nutritional recommendations of feedlot consulting nutritionists: The 2007 Texas Tech University survey *J. Anim. Sci.* 85:2772-2781.
- ⁴ Gorocica-Buenfil, M. A., F. L. Fluharty, C. K. Reynolds, and S. C. Loerch. 2007. Effect of dietary vitamin A concentration and roasted soybean inclusion on marbling, adipose cellularity, and fatty acid composition of beef *J. Anim. Sci.* 85:2230-2242.
- ⁵ Gorocica-Buenfil, M. A., F. L. Fluharty, C. K. Reynolds, and S. C. Loerch. 2007. Effect of dietary vitamin A restriction on marbling and conjugated linoleic acid content in Holstein steers *J. Anim. Sci.* 85:2243-2255.
- ⁶ Pyatt, N. A., L. L. Berger, and T. G. Nash. 2005. Effects of vitamin A and restricted intake on performance, carcass characteristics, and serum retinol status in Angus x Simmental feedlot cattle. *Prof. Anim. Sci.* 21:318-331.
- ⁷ Bryant, T. C., J. J. Wagner, T. E. Engle, K. L. Dorton, P. D. Burns, and M. L. Galyean. 2004. Effects of dietary supplemental vitamin A concentration on growth, intake, and marbling in yearling feedlot steers. *J. Anim. Sci.* 82 (Suppl. 1):270 (Abstr.).
- ⁸ Kohlmeier, R. H. and W. Burroughs. 1970. Estimation of critical plasma and liver vitamin A levels in feedlot cattle with observations upon influences of body stores and daily dietary requirements *J. Anim. Sci.* 30:1012-1018.
- ⁹ Whitney, T. R., G. C. Duff, J. K. Collins, D. W. Schafer, and D. M. Hallford. 2006. Effects of diet for early-weaned crossbred beef steers on metabolic profiles and febrile response to an infectious bovine herpesvirus-1 challenge. *Livest. Sci.* 101:1-9.

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