



# BEEF CATTLE RESEARCH UPDATE

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## **Effect of Supplemental Vitamin A Concentrations on Marbling in Feedlot Cattle**

In my September 2007 Beef Cattle Research Update, I reviewed research evaluating the potential effects of vitamin A on marbling deposition in beef cattle. This review suggested that feeding no supplemental vitamin A to feedlot cattle might increase marbling deposition. This review also suggested that feeding supplemental vitamin A at levels exceeding the 2000 Beef NRC recommendation did not improve performance in feedlot cattle. The Beef NRC recommends a dietary vitamin A concentration of 1,000 IU/lb of dry matter for feedlot cattle. 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).<sup>1</sup> The length of time for which no vitamin A is fed appears to be important; the longer the period of vitamin A restriction is, the greater the marbling response. The nutritional and management history or background of cattle prior to entering the feedlot also affects 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.<sup>2</sup>

Recent Kansas State University evaluated the effects of feeding no supplemental vitamin A or high levels of vitamin A (seven times the NRC recommended level) to early and traditionally weaned calves during finishing on carcass marbling development, USDA quality grade, color display life, lipid oxidation, and sensory attributes of two beef muscles.<sup>3,4</sup> In this study, 48 Angus crossbred calves were either early-weaned (EW) at 137 days of age or traditionally-weaned (TW) at 199 days of age. At weaning, the calves were placed in the feedlot and either supplemented with (~7,000 IU/lb of diet) or without vitamin A. The experimental feeding period consisted of a growing and finishing phase for EW calves and finishing only for TW calves. Vitamin A supplementation was initiated upon arrival at the feedlot following a 14 day preconditioning period. The steers consumed the treatment diets for either 210 days (EW) or 150 days (TW).

Similar to that observed in previous research (September 2007 Beef Cattle Research Update), it was reported that vitamin A level did not affect gains of the cattle or any carcass characteristics other than marbling. Backfat thickness was numerically reduced when no supplemental vitamin A was fed (Table 1). However, cattle fed no supplemental vitamin A had higher marbling scores. This increased marbling appeared to be enhanced with early weaning possibly because these EW calves were on restricted vitamin A diets for a longer period of time than TW calves. EW steers fed no supplemental vitamin A produced carcasses with the greatest marbling scores, but this difference was not statistically significant. The percentage of intramuscular fat was 20% greater in steers fed no supplemental vitamin A compared with steers fed vitamin A. As a result, the percentage of carcasses grading premium choice or greater was doubled in steers fed no supplemental vitamin A, regardless of weaning age.

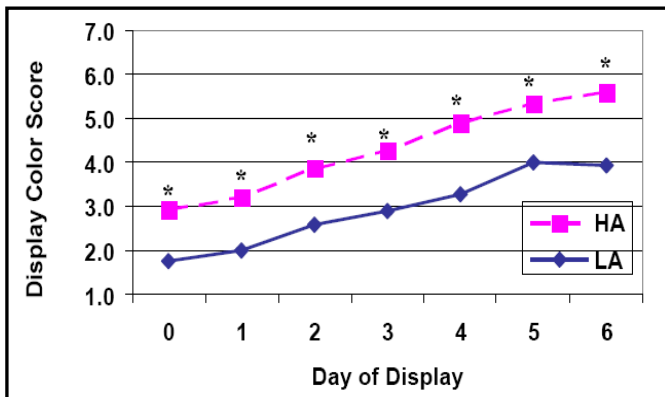
**Table 1.** Carcass traits of steers weaned at either early or traditional ages fed diets with or without supplemental vitamin A.

Item	High Vitamin A		No Vitamin A		P-values		
	Weaning Age		Weaning Age		Vit. A	Wean	Vit A x Wean
	Early	Traditional	Early	Traditional			
Backfat thickness, in.	0.46	0.43	0.36	0.33	0.33	0.74	0.98
Marbling Score <sup>1</sup>	430	440	480	450	0.03	0.04	0.77
Intramuscular fat, %	4.8	4.8	6.2	5.3	0.01	0.03	0.73
Premium Choice and Prime, %	17	18	36	36	----	----	----

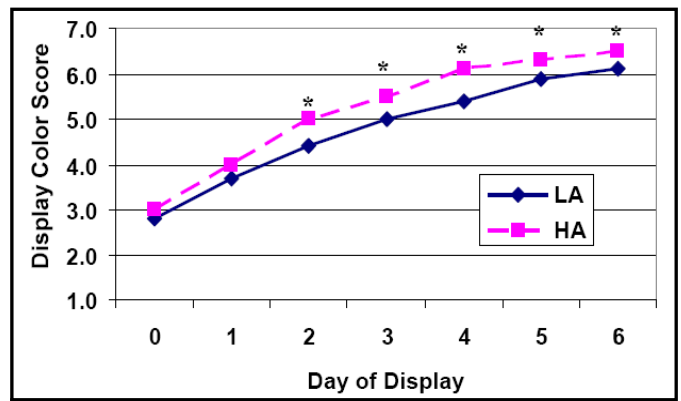
<sup>1</sup>Marbling score: 400 = Small<sup>00</sup>, 500=Modest<sup>00</sup>, etc.

Source: Arnett et al., 2008

These researchers also reported that steaks from calves supplemented with high vitamin A levels had less desirable visual display color scores than steaks from calves fed no supplemental vitamin A on all days of display for *Longissimus lumborum* steaks (strip loin steaks; Figure 1) and on days 2 through 6 for *Triceps brahciai* steaks (chuck muscles; Figure 2). Lipid oxidation was higher for both muscles after 7 days of display in steaks from steers fed high levels of vitamin A (Figure 3). This increase in lipid oxidation indicates that retail shelf life would be reduced. No differences in tenderness, as measured by Warner-Bratzler shear force, between vitamin A treatments were observed for either muscle. There were also no differences in sensory panel attributes for the *Triceps brahciai* steaks (used trained sensory panels). However, *Longissimus lumborum* steaks from steers supplemented with high vitamin A levels had lower sensory panel scores for myofibrillar tenderness and connective tissue amount.



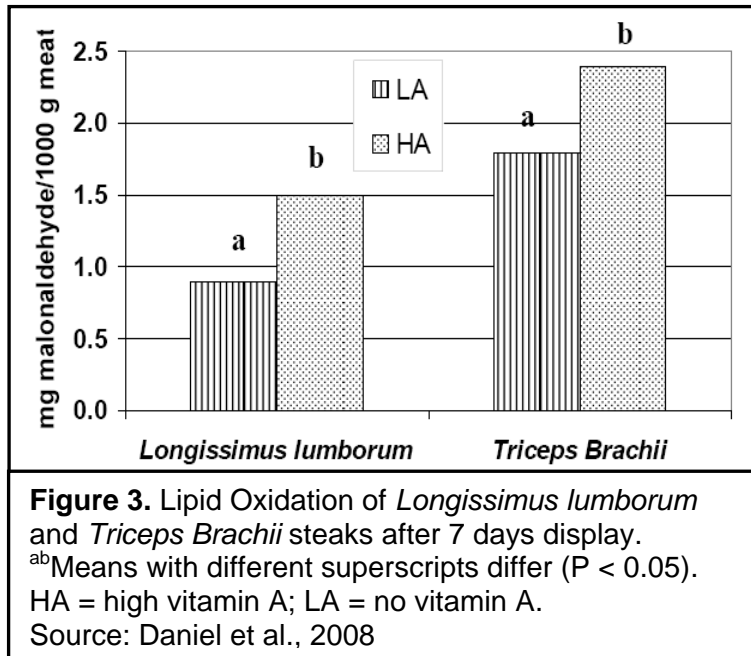
**Figure 1.** Display color scores for *Longissimus lumborum* steaks. Display color scores: 1 = most desirable; 8 = least desirable. \*Means differ (P < 0.05). HA = high vitamin A; LA = no vitamin A. Source: Daniel et al., 2008



**Figure 2.** Display color scores for *Triceps brahciai* steaks. Display color scores: 1 = most desirable; 8 = least desirable. \*Means differ (P < 0.05). HA = high vitamin A; LA = no vitamin A. Source: Daniel et al., 2008

In summary, it was concluded that feeding diets with no supplemental vitamin A to feedlot cattle for at least 150 days is a safe and effective method of improving carcass marbling and USDA quality grades without increasing external fat thickness. This data suggested that the benefits of feeding no supplemental vitamin A were enhanced with early weaning and (or) restricting vitamin A for up to 210 days. In addition, vitamin A restriction during finishing appears to have the potential to increase color display life and reduce lipid oxidation in

*Longissimus lumborum* and *Triceps brahcia* steaks without negatively affecting cooked meat sensory attributes.



- <sup>1</sup> 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.
- <sup>2</sup> 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.
- <sup>3</sup> Arnett, A. M., M. J. Daniel, and M. E. Dikeman. 2008. Restricting vitamin A in cattle diets improves beef carcass marbling and USDA quality and yield grades. *Kansas State Univ. Beef Cattle Research 2008 Report of Progress* 95:24-27.
- <sup>4</sup> Daniel, M. J., M. E. Dikeman, and A. M. Arnett. 2008. Vitamin A restriction during finishing benefits beef retail color display life. *Kansas State Univ. Beef Cattle Research 2008 Report of Progress* 95:28-30.

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