BEEF CATTLE RESEARCH UPDATE

Britt Hicks, Ph.D., PAS
Area Extension Livestock Specialist
Oklahoma Panhandle Research & Extension Center

January 2017

The Effect of Supplemental Zinc-Amino Acid Complex and Ractopamine Hydrochloride on the Performance of Finishing Beef Cattle

Ractopamine hydrochloride (Optaflexx®, Elanco Animal Health) is approved for increased rate of weight gain, improved feed efficiency, and increased carcass leanness in cattle fed in confinement for slaughter during the last 28 to 42 days on feed. A recently published (2016) survey of consulting feedlot nutritionists indicated that approximately 84.8% of the clients serviced by the nutritionists used some type of β-adrenergic agonist in their finishing cattle diet.[1] Due to the recent withdrawal of products containing zilpaterol hydrochloride from the U.S. market, 95.5% of the nutritionists in this survey indicated that ractopamine hydrochloride (RAC) was most commonly used as the β-adrenergic agonist.

Zinc is a trace mineral required for the growth and development of animals. Research in pigs has shown that supplementing additional zinc to pigs fed RAC improved daily gains and efficiency over RAC alone.[2,3] In addition, data from large pen feedlot studies have indicated that zinc may elicit a similar response in finishing cattle fed RAC[4]. In these feedlot studies, the source of added zinc came in the form of an amino acid complex (ZnAA). Iowa State University researchers recently evaluated the effect of feeding a supplemental zinc-amino-acid complex (Availa-Zn®, Zinpro Corporation) in combination with RAC (Optaflexx®) on the performance and carcass characteristics of finishing beef cattle in two different projects to determine whether ZnAA supplementation would alter the growth response of steers fed RAC.[5,6]

In the first study, 42 steers (average initial weight = 838 lb) were assigned to one of four treatments for 86 days (pre-RAC period): a dry-rolled corn based diet supplemented with 60 ppm zinc dry matter (DM) from zinc sulfate and no supplemental ZnAA (control diet, analyzed 88 ppm zinc, 6 steers) or the control diet supplemented with 30 (Zn30; 12 steers), 60 (Zn60; 12 steers), or 90 (Zn90; 11 steers) ppm zinc DM from ZnAA.[5] On day 88 of the study, half of the pens of steers on treatments that included supplemental ZnAA were randomly selected to be supplemented with RAC at 300 mg/steer/day for the final 28 days of the experiment.

During the pre-RAC period, there was a tendency for a quadratic effect of zinc ($P \leq 0.10$) on average daily gain (ADG) and gain efficiency (G:F ratio). Control cattle (4.52 lb/day and 0.181 G:F) and cattle fed Zn30 (4.37 lb/day and 0.174 G:F) performed similarly while performance increased to the greatest in Zn60 (4.85 lb/day and 0.197 G:F) followed by a decrease in performance for Zn90 steers (4.18 lb/day and 0.168 G:F).

During the 28 day RAC period, as would be expected steers supplemented with RAC had greater final body weights (BW), ADG, and G:F than non-RAC supplemented steers ($P \leq 0.001$, Table 1). In addition, as supplemental ZnAA increased within the RAC-supplemented treatments, there was a linear increase in final BW, ADG, and G:F as dietary zinc concentration increased ($P \leq 0.03$). However, there was no effect of supplemental ZnAA on final BW, ADG, or G:F during this period in non-RAC fed steers. Despite the improvement in performance during the RAC period when cattle received RAC and ZnAA supplementation, hot carcass weight (HCW) was not influenced by RAC or zinc supplementation. The authors noted that performance during the pre-RAC period had a greater influence on the overall outcome of the study, possibly due to increased variation among the small number of steers utilized in the study.

Table 1. Effect of ZnAA and RAC on growth performance during the RAC period.

Item	Control	Without RAC			With RAC			P-value	
		Zn30	Zn60	Zn90	Zn30	Zn60	Zn90	A[1]	B[2]
Day 86 BW, lb	1228	1261	1270	1173	1217	1213	1211	0.320	0.86
Final BW, lb	1321	1319	1305	1314	1325	1330	1352	0.001	0.03
ADG, lb/day	3.13	3.06	2.67	2.93	3.31	3.44	4.19	0.001	0.02
G:F	0.131	0.126	0.108	0.129	0.134	0.141	0.166	0.003	0.03

[1]A = effect of RAC supplementation (Zn30, Zn60, and Zn90 without RAC vs. Zn30, Zn60, and Zn90 with RAC).
[2]B = linear effect of ZnAA within RAC supplemented treatments.
Adapted from Genther-Schroeder et al., 2016a.

These researchers concluded that “supplementing ZnAA at 60 ppm zinc tended to improve performance during the initial 86 days of the 116 day finishing period”. However, “during the final 28 days while RAC was included in the diet, supplementing 90 ppm zinc DM had the greatest effect on the response to RAC, suggesting that zinc may enhance or support the biological function of RAC”.

In the second study, two groups of steers (average initial weight = 1022 lb) were fed concurrently a corn-based finishing diet that included 60 ppm supplemental zinc from zinc sulfate, for 91 (Group 1, 140 steers) or 84 days (Group 2, 180 steers).[6] The steers were assigned to receive either 0 (Controls: analyzed total diet zinc concentration = 85 ppm) or 60 ppm supplemental zinc from ZnAA (analyzed total diet zinc concentration = 150 ppm). Forty-two days prior to slaughter, pens within the dietary treatments were equally assigned to receive RAC at 300 mg/steer/day for 0, 28, or 42 days prior to slaughter.

These researchers reported that feeding supplemental ZnAA for 49 (Group 1) or 42 days (Group 2) prior to the start of RAC feeding had no impact on growth of the steers ($P \geq 0.19$). These results contrast with those seen in the first study where supplementing 60 ppm zinc DM from ZnAA tended to improve steer performance (pre-RAC period was 86 days).

The effect of ZnAA and RAC feeding duration on carcass characteristics and carcass-adjusted performance are shown in Table 2. RAC supplementation increased (HCW) by 1.2%, ribeye area by 2.5% and carcass-adjusted final BW by 1.2%, overall ADG by 4.6%, and gain efficiency (G:F) by 5.2% ($P \leq 0.004$). In this study, the response to 42 days of RAC supplementation was less than that seen with 28 days of supplementation. The authors noted that the reason for this response is unclear.

Table 2. Effect of ZnAA and RAC feeding duration on carcass characteristics and carcass-adjusted performance[1].

	Dietary Treatment						P-value		
	Controls			ZnAA				Effect of zinc within	
	RAC Feeding Duration, days[2]								
	NoRAC	28RAC	42RAC	NoRAC	28RAC	42RAC	RAC[3]	28RAC[4]	42RAC[5]
HCW, lb	897	904	902	900	917	913	0.004	0.04	0.05
Ribeye area, sq. in.	13.6	14.0	14.0	13.7	14.0	14.1	0.007	0.78	0.71
Final BW, lb	1411	1422	1416	1413	1442	1435	0.004	0.04	0.05
Overall ADG, lb/day	4.45	4.59	4.52	4.45	4.81	4.72	0.004	0.05	0.10
Overall G:F	0.175	0.180	0.177	0.171	1.88	0.183	0.0002	0.04	0.13

[1]Carcass-adjusted performance was calculated by dividing HCW by the average dressing percentage (63.6%).
[2]RAC feeding duration: 300 mg/steer/day for 0 (NoRAC), 28 (28RAC), or 42 (42RAC) days.
[3]RAC = NoRAC vs. 28RAC, 42RAC.
[4]28RAC = Controls vs. ZnAA within 28RAC (Control + 28RAC vs. ZnAA + 28RAC).
[5]42RAC = Controls vs. ZnAA within 42RAC (Control + 42RAC vs. ZnAA + 42RAC).
Adapted from Genther-Schroeder et al., 2016b.

Similar to the results of the first study, the response to RAC was greater in steers fed supplemental ZnAA (increased carcass-adjusted ADG, $P \leq 0.10$; final BW and HCW, $P \leq 0.05$; and G:F relative; $P < 0.13$) relative to control steers. However, when steers did not receive RAC there was no effect of ZnAA on final BW, ADG, G:F, or HCW. In addition, ZnAA supplementation had no effect on the difference in performance between steers supplemented with RAC for 28 vs. 42 days.

In conclusion, in this study supplementing a zinc-amino-acid complex (60 ppm zinc) increased the live performance and carcass response of steers supplemented with ractopamine hydrochloride. These researchers noted that these results suggest that there appears to be a synergy between ZnAA and RAC that further increases the performance of cattle during the final 28 days of the finishing period. They also noted that the additional hot carcass weight in the zinc-supplemented, RAC-fed cattle represents an economic opportunity for the cattle feeder to optimize cattle performance.

---

[1] Samuelson, K. L., M. E. Hubbert, M. L. Galyean, and C. A. Löest. 2016. Nutritional recommendations of feedlot consulting nutritionists: The 2015 New Mexico State and Texas Tech University survey. J. Anim. Sci. 94: 2648-2663.

[2] Patience, J. F. and A. Chipman. 2011. Impact of zinc source and timing of implementation on grow-finish performance, carcass composition and locomotion score. Iowa State University Animal Industries Report: AS 657 A.S. Leaflet R2655. Available: http://lib.dr.iastate.edu/ans_air/vol657/iss1/79/.

[3] Paulk, C. B., D. D. Burnett, M. D. Tokach, J. L. Nelssen, S. S. Dritz, J. M. DeRouchey, R. D. Goodband, G. M. Hill, K. D. Haydon, and J. M. Gonzalez. 2015. Effect of added zinc in diets with ractopamine hydrochloride on growth performance, carcass characteristics, and ileal mucosal inflammation mRNA expression of finishing pigs12. J. Anim. Sci. 93: 185-196.

[4] Larson, C. K. and M. E. Branine. 2015. Effect of zinc amino acid complex on growth performance and carcass characteristics of finishing beef steers fed ractopamine hydrochloride. J. Anim. Sci. 93 (Suppl. S3): 443 (Abstr.).

[5] Genther-Schroeder, O. N., M. E. Branine, and S. L. Hansen. 2016a. The effects of increasing supplementation of zinc-amino acid complex on growth performance, carcass characteristics, and inflammatory response of beef cattle fed ractopamine hydrochloride. J. Anim. Sci. 94: 3389-3398.

[6] Genther-Schroeder, O. N., M. E. Branine, and S. L. Hansen. 2016b. The influence of supplemental Zn-amino acid complex and ractopamine hydrochloride feeding duration on growth performance and carcass characteristics of finishing beef cattle. J. Anim. Sci. 94: 4338-4345.