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Effects of delaying the initial combination implant on performance and carcass characteristics of feedlot heifers[1]

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Introduction

Newly arrived calves at a feedlot are often highly stressed. The combination of stress and comingling with other cattle of different origins during assembly and transportation increases the calf's susceptibility to disease. Stressed calves that are potentially affected by disease have poor growth performance in a feedlot for various reasons, including low feed intake (Galyean et al., 1999) and altered nutrient metabolism (Waggoner et al., 2009).

Current industry practices are to implant calves with anabolic compounds shortly after arrival to the feedlot. According to Trenkle (1997), anabolic implants enhance muscle growth by affecting various components of the animal's endocrine function and metabolism, such as up-regulation of the somatotropic axis that results in increased production of growth hormone and insulin-like growth factor-I (**IGF-I**). However, disease and inflammation alter animal metabolism and the endocrine environment, and cause decreases in growth hormone and IGF-I possibly due to uncoupling of the somatotropic axis (Sartin et al., 1998; Elsasser et al., 2008). Changes in the animal's metabolism allow catabolic processes of the immune response to dominate, and nutrients are directed away from growth to support an activated immune system (Sartin et al., 1998). Therefore, growth responses to an anabolic implant may be limited by potential uncoupling of the somatotropic axis, reprioritization of nutrients to support immune function, and low feed intake of newly received feedlot calves affected by disease.

We hypothesized that newly received calves would be more prepared for the growth demands of an implant if allowed to adapt to the feedlot environment, recover from stress and disease, and attain adequate nutrient intake before the application of an initial growth implant. Therefore, the objectives of this study were to evaluate the effects of delaying the initial growth implant on performance, health, carcass characteristics, and biomarkers of crossbred heifers.

Experimental Procedures

Cattle. All procedures were approved by the New Mexico State University Animal Care and Use Committee. In October 2010, 424 crossbred heifers were purchased from sale barns in the Southeastern US, and shipped to the Clayton Livestock Research Center. At initial processing, heifers were individually weighed (Silencer, Moly Manufacturing, Inc., Lorraine, KS), uniquely identified with individual ear tags, vaccinated against clostridial and viral diseases (Ultrabac 7 and Titanium 5; Pfizer Animal Health, Exton, PA and AgriLabs, St. Joseph, MO), and dosed with an external parasiticide (Noromectin; Norbrook, Inc., Lenexa, KS). Horns were tipped as necessary, and all heifers were inspected for the presence of previous implants. A single tissue sample (ear notch) was obtained from each heifer to test for persistently infected bovine viral diarrhea virus at Central States Testing (Dalhart, TX). Stipulations for exclusion of a heifer from this study included signs of lameness, diagnosis with bovine respiratory disease complex upon arrival, discovery of a previous implant, and if positively diagnosed with persistently infected bovine viral diarrhea virus (one calf was positive).

Experimental Design and Treatments. Four hundred and eight heifers with an initial body weight of 440 ± 2.8 lb were assigned to 24 sorting pens (17 heifers per pen) based on the order of arrival to the chute. Sorting pens were randomly assigned to one of 24 soil-surfaced feedlot pens (40 ft by 115 ft) equipped with fence line bunks (36 ft bunk line) and continuous flow water tanks. Each pen of heifers was then randomly assigned to one of 3 treatments

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(8 pens per treatment). Treatments were: 1) no implant during the receiving period (**CON**), 2) an implant at the time of initial processing (**IMP1**), and 3) an implant 21 days after initial processing (**IMP21**). The initial implant was Revalor-H (140 mg of trenbolone acetate and 14 mg estradiol; Intervet/Schering Plough Animal Health, Millsboro, DE).

Management and Feeding. Post-arrival metaphylaxis was not initially included in the protocol for this experiment. However, within 72 hours following arrival, the health of all calves began to decline rapidly due to an outbreak of *Pasteurella multocida*, and treatment with tulathromycin (Draxxin; Phizer Animal Health, Exton, PA) at 1.1 mL per 100 lb of body weight was recommended by veterinarians. All heifers were revaccinated 21 days after initial processing, and heifers received a terminal implant of 200 mg of trenbolone acetate and 20 mg estradiol (Revalor-200; Intervet/ Schering Plough Animal Health, Millsboro, DE) on day 126 of the study.

Heifers were fed a 68, 75, 82, and 91% concentrate diet (Table 1) from day 1 to 21, day 22 to 63, day 64 to 126, and day 127 to 222 (finish), respectively. Diets were mixed in an overhead mixer, and delivered to pens of cattle once daily. Estimates of the quantity of unconsumed feed remaining in the feed bunks were made at approximately 7:00AM daily, and feed delivery was managed to minimize accumulation of orts in feed bunks. Weekly samples of feedstuffs and complete diets were obtained to analyze for dry matter. Nutrient analyses of composited feed samples were conducted by a commercial laboratory (SDK Labs, Hutchinson, KS). Orts were collected weekly, weighed, and a sample was analyzed for dry matter in order to correct dry matter intake.

Five heifers were randomly selected from each pen for collection of blood samples from their jugular vein on days 1, 21, and 42. The same heifers were used for blood collection on each day, unless they had been removed from the experiment due to chronic morbidity or mortality. Blood samples were analyzed for IGF-I and haptoglobin. Heifers were individually weighed in a single animal squeeze chute and scale suspended from two load cells on day 1, 21, 42, and 126. The scale was calibrated with 1000-lb certified weights before the recording of animal body weights began. At 222 days on feed, all heifers were weighed using a pen scale and shipped to a commercial abattoir in Amarillo, TX. Carcass data were collected by trained personnel from Cattlemen's Carcass Data Service (West Texas A & M University, Canyon, TX). The data collected included hot carcass weight, rib-eye area, 12th rib back fat, kidney, pelvic, and heart fat, marbling score, USDA quality grade, and USDA yield grade. Livers were evaluated for presence and severity of abscesses and were either not condemned or scored (A-, A, A+). Carcasses which were railed out with excessive trim were not used in analyzing hot carcass weight and dressing percent data.

Statistical Analyses. Dry matter intake, performance, and non-categorical carcass data were analyzed as a completely randomized design using the MIXED procedure of SAS (SAS Inst. Inc., Cary, NC) with pen as the experimental unit. Haptoglobin and IGF-I were analyzed statistically with a repeated measures component. Carcass quality and yield grades, liver abscesses, and health data were analyzed as binomial proportions using the GLIMMIX procedure of SAS.

Results

Serum haptoglobin concentrations of heifers were not affected (P = 0.59) by implant strategy, but were greater (P < 0.01) on day 1 (139 ± 4.9 mg/dL) than on day 21 (25 ± 4.9 mg/dL) and day 42 (25 ± 4.9 mg/dL). Serum IGF-I concentrations (Figure 1) were not different among treatments on day 1, were greater for IMP1 than CON and IMP21 on day 21, and were greater for IMP21 than CON on day 42 (treatment by day interaction, P = 0.01).

On day 21, body weights of heifers were greater (P ≤ 0.05) for IMP1 than CON and IMP21 (Table 2), whereas body weights of heifers on days 42, 126, and 222 (final) were greater (P ≤ 0.05) for IMP1 and IMP21 than CON. Also, heifer body weights tended to be greater (P = 0.07) for IMP21 than IMP1 on day 222. Carcass-adjusted final body weights were greater (P ≤ 0.05) for IMP21 than CON, but carcass-adjusted final body weights for IMP1 were intermediate and not different from CON or IMP21.

From day 1 to 21, dry matter intake was not different (P = 0.34) among heifers, and average daily gain and gain-to-feed ratio were greater (P ≤ 0.05) for IMP1 than CON, and lower (P ≤ 0.05) for IMP21 than CON. From day 22 to 42, dry matter intake of heifers was not different (P = 0.23), whereas average daily gain was greater (P ≤ 0.05) for IMP1 and IMP21 than CON. Gain-to-feed ratio from day 22 to 42 was greater (P ≤ 0.05) for heifers that received IMP21 than CON, but gain-to-feed ratio for IMP1 heifers was intermediate and not different from CON or IMP21 heifers. From day 43 to 126, dry matter intake was greater (P ≤ 0.05) for IMP1 and IMP21 than CON, but average daily gain and gain-to-feed ratio were not different (P ≥ 0.43) among treatments. From day 127 to 222 (finish), dry matter intake was greater (P ≤ 0.05) for IMP21 than IMP1 and CON, and average daily gain and gain-to-feed ratio were not different (P ≥ 0.12) among treatments. During the entire feeding period (day 1 to 222), dry matter intake was greater (P ≤ 0.05) for IMP1 and IMP21 than CON heifers. Average daily gain was greater (P ≤ 0.05) for IMP21 than CON, and intermediate for IMP1 and not different from CON or IMP21 during the entire feeding period. Also, carcass-adjusted average daily gain tended to be greater (P = 0.06) for IMP21 than CON. During the entire feeding period (day 1 to 222), gain-to-feed ratio and carcass-adjusted gain-to-feed ratio were not different ($P \geq 0.25$) among treatments.

Hot carcass weights were heavier ($P \leq 0.05$) for IMP21 than CON, but hot carcass weights for IMP1 were intermediate and not different from CON or IMP21 (Table 3). The percentage of yield grade 3 carcasses were greater ($P \leq 0.05$) for IMP21 than CON, and intermediate for IMP1. Implant strategy did not affect ($P \geq 0.11$) other carcass characteristics or percent liver abscesses.

All heifers were treated at least once with tulathromycin. However, timing of initial implant strategy did not affect ($P \geq 0.44$) the percentage of heifer treated two or three times, nor the percentage of death loss (Table 4).

Discussion

Within 72 hours after arrival, health of all heifers began to decline rapidly, which was due to *Pasteurella multocida* according to diagnosis by veterinarians. Therefore, all heifers received post-arrival metaphylaxis with tulathromycin (Draxxin). Due to this bacterial infection outbreak, the percentage of death loss among all pens of calves was approximately 8.5%. Also, all calves had high blood concentrations of haptoglobin on day 1 of the study. Haptoglobin is an acute-phase protein that is produced in response to inflammation and gram-negative bacterial infection in cattle (Waggoner et al., 2009).

In newly received feedlot calves that are exposed to infection, growth responses to an anabolic implant may be limited by potential uncoupling of the somatotropic axis (Elsasser et al., 2008), repartitioning of nutrients (Waggoner et al., 2009), and low feed intake (Galyean et al., 1999). Therefore, we hypothesized that newly received calves would be more prepared for the growth demands of an anabolic implant if allowed to adapt to the feedlot environment, recover from stress and disease, and attain adequate nutrient intake before the initial implant. In the current study, high blood haptoglobin concentrations on day 1 and an 8.5% death loss indicated that heifers were exposed to vectors of disease before arrival at the feedlot. Also, dry matter intakes during the first 21 days of this study were only 1.6 to 1.7% of the average body weight of heifers regardless of implant strategy. Nevertheless, blood concentrations of IGF-I were greater in heifers that received a growth implant at initial processing compared with heifers that received either no implant during the receiving period or a growth implant 21 days after initial processing. Greater blood IGF-I concentrations in response to a growth implant in calves exposed to disease indicated that potential uncoupling of the somatotropic axis was not a major problem in these heifers. Greater body weights on day 21, as well as greater average daily gain and gain-to-feed ratio during the first 21 days for heifers that received a growth implant at initial processing compared with heifers that received either no initial implant or a growth implant 21 days after initial processing indicated that the efficacy of the implant was not negatively affected by disease or low feed intake.

During the first 21 days, management, feeding, and treatment of heifers that received a growth implant 21 days after initial processing were similar to the control heifers. Therefore, differences in performance and feed efficiency were not expected between these two groups during the first 21 days. However, heifers that received no initial implant tended to have lighter body weights at the beginning of the study but numerically greater dry matter intakes than heifers that did receive initial growth implants, which could have contributed to some of the differences in performance.

On day 42, body weights of heifers that received a growth implant on day 21 were greater than body weights of control heifers, but were similar to body weights of the heifers that received an implant at initial processing. Performance and feed efficiency from day 22 to 42 was greater for heifers that received an implant on day 21 than control heifers. Although not statistically significant, average daily gain and gain-to-feed ratio from day 22 to 42 was 15% and 19% greater for heifers that received the growth implant on day 21 versus day 1. Similar body weights on day 42, and numerically greater average daily gain and gain-to-feed ratio from day 22 to 42 among heifers that received the growth implant on day 21 versus day 1 indicated that heifers were able to compensate from days 22 to 42 for loss of performance during days 1 to 21. Therefore, delaying the initial implant for 21 days did not negatively affect animal performance by day 42.

The results of this study are somewhat different to the results of McDaniel et al. (2012), who evaluated the effects of delaying the initial growth implant and bovine viral diarrhea virus vaccine for 28 days on performance of feedlot heifers. In contrast to the current study, McDaniel et al. (2012) reported that delaying the implant decreased both dry matter intake and average daily gain during the 56-day study. Different results between the current study and the study of McDaniel et al. (2012) could be due to differences in implant strength and chemistry (androgenic versus estrogenic), as well as differences in the days of implant delay (21 days versus 28 days).

In the current study, heifer final body weights (day 222), as well as overall (day 1 to 222) dry matter intake, average daily gain, and gain-to-feed ratio for heifers that received a delayed implant were similar to those for heifer that received an implant at initial processing, which indicates that delaying the growth implant for 21 days does not have a detrimental impact on overall cattle performance in the feedlot. Although not statistically significant, a 4% improvement in overall gain (day 1 to 222), 23 lb heavier final body weights on day 222, and 10 lb heavier hot carcass weights for heifer that received the growth implant on day 21 versus day 1 could be due to the timing of the initial implant (Revalor-H) relative to the timing of the terminal implant (Revalor-200 on day 126 of the study). Because final body weight is important for marketing cattle on a live basis, heavier finishing weights could represent an economic benefit. Also, greater hot carcass weights could potentially increase the economic value of cattle sold on a carcass basis.

A shift towards more yield grade 3 carcasses and less yield grade 4 carcasses for heifers that received the initial implant on day 21 compared with no initial implant indicated that the delayed implant strategy increased carcass cutability. Implant strategy did not affect other carcass characteristics or percentage of liver abscesses.

No differences among implant strategies for the percentage of calves pulled 2 or 3 times, as well as for the percentage death loss, indicated that the growth implants did not affect cattle health.

Conclusions

Delaying the initial implant by 21 days did not significantly alter overall performance, health, or carcass characteristics of heifers compared with implanting at initial processing. Numerical improvements in average daily gain, final body weight, and hot carcass weight when delaying the initial implant by 21 days may have economical implications that are dependent upon how cattle are marketed.

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Table 1. Ingredient and nutrient composition of diets

	Dietary concentrate[1], %			
Item, % of DM	68	75	82	91
Ingredient				
Steam flaked corn	41.3	47.0	50.0	59.9
Wheat hay	32.0	25.0	18.0	-
Wheat silage	-	-	-	9.0
Sweetbran	15.0	20.0	25.0	25.0
Soybean meal	5.8	2.5	1.0	-
Molasses	3.0	1.5	-	-
Tallow	-	1.5	2.5	2.5
Supplement[2]	2.5	2.5	3.0	3.0
Urea	0.4	0.5	0.5	0.6
Nutrient[3]				
NDF	27.9	25.6	23.3	20.9
CP	15.1	16.4	15.3	15.1
Ca	0.77	0.71	0.99	0.82
P	0.38	0.44	0.48	0.45
S	0.24	0.24	0.24	0.24

[1]Heifers were fed the 68, 75, 82, and 91% concentrate diets from day 1 to 21, day 22 to 63, day 64 to 126, and day 127 to 222 (finish), respectively.

[2]Contained: 75% limestone; 6% potassium chloride; 10.89% salt; 2.5% magnesium oxide; 1.42% microminerals; 0.6% vitamins A and E; 0.72% Rumensin-80 (176 g/kg monensin; Elanco Animal Health, Indianapolis, IN); 0.48% Tylan-40 (88 g/kg tylosin; Elanco Animal Health); 0.39% MGA-200 (0.44 g/kg melengestrol acetate; Pfizer Animal Health, New York, NY); 2.0% mineral oil.

[3]Analysis by SDK Labs, Hutchinson, KS.

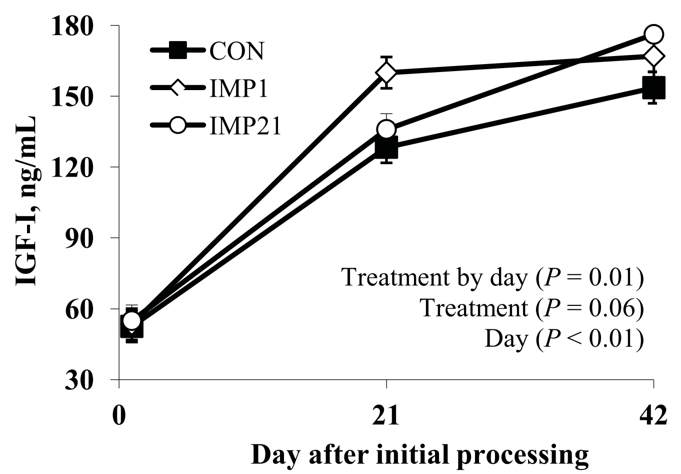

Figure 1. Effects of timing of an initial combination implant on serum concentrations of insulin-like growth factor-I (**IGF-I**). Treatments were 1) no implant during the receiving period (**CON**), 2) an implant at the time of initial processing (**IMP1**), and 3) an implant 21 days after initial processing (**IMP21**). The initial implant was Revalor-H (140 mg trenbolone acetate and 14 mg estradiol; Intervet/Schering Plough Animal Health, Millsboro, DE).

Table 2. Effects of timing of an initial combination implant on dry matter intake and performance of heifers

	Treatment[1]				
Item	CON	IMP1	IMP21	SEM	*P*-value
No. of pens	8	8	8	-	-
Body weight, lb					
Day 1	435	444	442	2.81	0.08
Day 21	475[b]	491[a]	472[b]	4.25	<0.01
Day 42	527[b]	558[a]	549[a]	5.17	<0.01
Day 126	779[b]	806[a]	810[a]	6.69	<0.01
Day 222 (final)[2]	1076[b]	1102[a]	1125[a]	8.42	<0.01
Carcass-adjusted[3]	1087[b]	1105[ab]	1121[a]	7.61	0.02
Day 1 to 21					
DM intake, lb	7.6	7.6	7.3	0.180	0.34
Daily gain, lb	1.90[b]	2.27[a]	1.44[c]	0.127	<0.01
Gain-to-feed ratio	0.247[b]	0.299[a]	0.196[c]	0.014	<0.01
Day 22 to 42					
DM intake, lb	14.0	14.6	14.1	0.241	0.23
Daily gain, lb	2.48[b]	3.16[a]	3.64[a]	0.223	<0.01
Gain-to-feed ratio	0.177[b]	0.216[ab]	0.257[a]	0.015	<0.01
Day 43 to 126					
DM intake, lb	16.8[b]	17.5[a]	17.7[a]	0.192	0.01
Daily gain, lb	3.00	2.96	3.11	0.087	0.47
Gain-to-feed ratio	0.179	0.169	0.176	0.005	0.43
Day 127 to 222 (final)[2]					
DM intake, lb	17.1[b]	17.6[b]	18.4[a]	0.236	<0.01
Daily gain, lb	3.16	3.15	3.35	0.072	0.12
Gain-to-feed ratio	0.185	0.179	0.182	0.004	0.43
Day 1 to 222 (final)[2]					
DM intake, lb	15.8[b]	16.3[a]	16.6[a]	0.171	<0.01
Daily gain, lb	2.89[b]	2.97[ab]	3.08[a]	0.040	0.01
Carcass-adjusted daily gain, lb	2.94	2.98	3.06	0.034	0.06
Gain-to-feed ratio	0.183	0.182	0.185	0.001	0.25
Carcass-adjusted gain-to-feed	0.186	0.182	0.184	0.003	0.67

[1]Treatments were 1) no implant during the receiving period (**CON**), 2) an implant at the time of initial processing (**IMP1**), and 3) an implant 21 days after initial processing (**IMP21**). The initial implant was Revalor-H (140 mg trenbolone acetate and 14 mg estradiol; Intervet/Schering Plough Animal Health, Millsboro, DE). On day 126, heifers on all treatments received a terminal implant (Revalor-200).

[2]On day 222, all heifers were weighed using a pen scale and shipped to a commercial abattoir in Amarillo, TX.

[3]Carcass-adjusted final body weight = hot carcass weight/0.6346.

[a,b,c] Means within a row not bearing a common letter differ ($P \leq 0.05$).

Table 3. Effects of timing of an initial combination implant on carcass characteristics of heifers

	Treatment[1]				
Item	CON	IMP1	IMP21	SEM	*P*-value
Number of pens	8	8	8	-	-
Hot carcass weight, lb	690[b]	701[ab]	711[a]	5.16	0.01
Rib-eye area, sq. in.	11.5	11.7	11.8	0.146	0.29
12^{th}-rib fat, in	0.66	0.68	0.69	0.019	0.55
KPH[2], %	2.98	2.99	2.94	0.027	0.42
Yield grade 1, %	2.4	4.8	1.6	1.08	0.11
Yield grade 2, %	28.3	20.2	18.1	4.48	0.25
Yield grade 3, %	40.8[b]	46.8[ab]	59.4[a]	4.87	0.03
Yield grade 4, %	25.3	23.5	16.2	4.47	0.33
Yield grade 5, %	3.3	4.7	4.8	1.90	0.81
Marbling score[3]	504	511	511	10.1	0.85
Choice or better, %	91.8	88.7	88.7	2.84	0.66
Select, %	8.2	11.3	11.3	2.84	0.66
Abscessed livers, %	5.74	4.03	5.65	2.11	0.80

[1]Treatments were 1) no implant during the receiving period (**CON**), 2) an implant at the time of initial processing (**IMP1**), and 3) an implant 21 days after initial processing (**IMP21**). The initial implant was Revalor-H (140 mg trenbolone acetate and 14 mg estradiol; Intervet/Schering Plough Animal Health, Millsboro, DE). On day 126, heifers on all treatments received a terminal implant (Revalor-200).

[2]KPH = kidney, pelvic, and heart fat.

[3]400 = Small^{00}, 500 = Modest^{00}.

[a,b,c] Means within a row not bearing a common letter differ ($P \le 0.05$).

Table 4. Effects of timing of an initial combination implant on morbidity and mortality

	Treatment[1]				
Item	CON	IMP1	IMP21	SEM	*P*-value
Pulled 2 times, %	4.41	2.21	2.21	1.38	0.44
Pulled 3 times, %	0.74	0.00	0.74	0.60	0.61
Death loss, %	8.82	7.35	9.56	2.29	0.79

[1]Treatments were 1) no implant during the receiving period (**CON**), 2) an implant at the time of initial processing (**IMP1**), and 3) an implant 21 days after initial processing (**IMP21**). The initial implant was Revalor-H (140 mg trenbolone acetate and 14 mg estradiol; Intervet/Schering Plough Animal Health, Millsboro, DE). On day 126, heifers on all treatments received a terminal implant (Revalor-200).

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