EFFECT OF IMPLANT STRATEGY AND OPTAFLEXX[1] ADMINISTRATION ON FEEDLOT PERFORMANCE AND SKELETAL MUSCLE β-ADRENERGIC RECEPTOR AND INSULIN-LIKE GROWTH FACTOR I mRNA ABUNDANCE

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Summary

Feedlot heifers (1,147) weighing 622 lb were used to evaluate the effects of implant strategy and Optaflexx administration. Implant treatments included Revalor[2]-200 (R200) at arrival, or Revalor-IH at arrival and reimplantation with Finaplix[2]-H on day 58 (RF). Optaflexx (200 mg/heifer daily of ractopamine-HCl) was fed the last 28 days. Treatments were randomly assigned to 16 pens. After 182 days, heifers were slaughtered, at which time carcass data were obtained and semimembranosus muscle tissue was excised for RNA isolation. Optaflexx administration significantly increased average daily gain (0.7 lb/day), feed efficiency (3%), hot carcass weight (10.5 lb), and ribeye area (0.42 square inches); decreased back fat thickness; and improved yield grade. There was no significant treatment effect on the expression of β1-adrenergic receptor (AR) mRNA, but there was a tendency for Optaflexx feeding to increase β2-AR mRNA concentrations. For β3-AR mRNA, Optaflexx treatment numerically increased β3-AR mRNA in heifers implanted with R200, but significantly decreased expression in heifers implanted with RF. Optaflexx also significantly decreased IGF-I mRNA in heifers implanted with RF, but numerically increased IGF-I mRNA in heifers implanted with R200. This data aids our understanding of the interaction between steroidal implants and Optaflexx in feedlot heifers. Knowledge about the modes of action of various growth promotants will aid in designing growth promotion strategies to enhance the efficiency of lean tissue deposition in feedlot cattle.

Introduction

Optaflexx is an orally active β-agonist (ractopamine-HCl) approved for use in feedlot cattle in the United States. It improves average daily gain, feed efficiency, carcass yield grade, hot carcass weight, and dressing percentage in feedlot steers when administered at the recommended daily dose of 200 mg/steer daily for the last 28 to 42 days of the feeding period. Optaflexx administration has resulted in more variable results in heifers than in steers. Optaflexx works through the β-AR; there are three different subtypes of β-AR found in cattle, with the β2-AR being the most abundant in bovine skeletal muscle. Optaflexx is believed to elicit its response through binding to the β1-AR. Binding to the β-AR leads to a cascade of events that is eventually followed by an increase in muscle protein synthesis and a decrease in protein degradation, which leads to an overall increase in lean tissue deposition.

[1]Optaflexx is a registered trademark of Elanco Animal Health, Indianapolis, IN.
[2]Revalor and Finaplix are registered trademarks of Intervet, Inc.

Steroidal implants are also used in feedlot animals to improve average daily gain, feed efficiency, and total lean tissue deposition. One of the mechanisms through which increased muscle growth is achieved with implants is through increased production of muscle insulin-like growth factor I (IGF-I). Insulin-like growth factor I is a potent stimulator of skeletal muscle growth.

The purpose of this trial was to investigate the effect of Optaflexx administration, in combination with implant strategy, on feedlot heifer performance and the expression of messenger RNA (mRNA) for IGF-I and the three β-AR subtypes.

Experimental Procedures

One thousand, one hundred forty-seven heifer calves with an initial weight of 622 lb were randomly assigned to 16 pens. One of four treatments was applied to each pen: 1) initial Revalor-200 (200 mg trenbolone acetate/20 mg estradiol-17β) without or 2) with Optaflexx (200 mg/heifer daily of ractopamine-HCl), 3) initial Revalor-IH (80 mg trenbolone acetate/8 mg estradiol-17β) and reimplantation (day 58) with Finaplix-H (200 mg trenbolone acetate) without or 4) with Optaflexx (200 mg/heifer daily of ractopamine-HCl). Heifers were fed three times daily and allowed *ad libitum* access to feed. The finishing diet consisted of 82.7% flaked corn, 5.1% alfalfa hay, 3.8% choice white grease, 2.5% cane molasses, and 5.9% of a finisher supplement, on a dry matter basis. Optaflexx was administered the last 28 days of the trial, and all heifers received melengestrol acetate (0.5 mg/heifer daily). Heifers were slaughtered after 182 days on feed, at which time semimembranosus muscle samples were obtained. For the gene expression work, two heifers per pen were analyzed. Total RNA was isolated from muscle samples and reverse transcribed into complimentary DNA. The complimentary DNA was generated for use in real-time, quantitative polymerase chain reaction to evaluate the expression of mRNA for IGF-I, β1-AR, β2-AR, and β3-AR.

Results and Discussion

Optaflexx administration significantly increased average daily gain and feed efficiency (Table 1). There was also a 10.5 lb increase in hot carcass weight, an increase in ribeye area, a decrease in back fat thickness, and improved yield grades in response to Optaflexx (Table 1). These responses to Optaflexx were similar to those typically observed for steers, and were larger than are often observed for heifers. These performance results are significant in that heifers have not always been observed to respond as well to the administration of Optaflexx as steers do. The response to Optaflexx in our study may be related to the implant strategy used.

There was no significant effect of treatments on the expression of β1-AR mRNA (Figure 1); there was a tendency for Optaflexx feeding to increase β2-AR mRNA (Figure 2). For the β3-AR mRNA, there was an implant by Optaflexx interaction, with Optaflexx leading to a numerical increase in β3-AR mRNA in heifers implanted with R200, but a significant decrease in heifers implanted with RF (Figure 3). There was also an implant by Optaflexx interaction on IGF-I mRNA, with Optaflexx leading to a significant decrease in IGF-I mRNA for heifers implanted with RF but numerical increases in IGF-I mRNA in heifers implanted with R200 (Figure 4).

The data from our study demonstrate that Optaflexx can have a positive effect on feedlot heifer performance and carcass characteristics. This may be related to the relative pay out of implants. At the initiation of Optaflexx feeding, the R200 group had been implanted for 154 days and the RF group had been

implanted with Finaplix-H for 96 days. Under these conditions, the potency of both implants at the time of Optaflexx initiation was likely negligible.

The performance response in our study was different than some others that have been unable to detect responses to Optaflexx in heifers. Those studies often used heifers implanted closer in time to the initiation of Optaflexx feeding. The differences between our results and those of others could suggest a possible interaction between implants and Optaflexx administration. Results of our study also suggest that Optaflexx may increase the expression of the β2-AR, which has been observed in some other studies performed by our laboratory. The data obtained from our study can aid in our understanding of the mechanisms of action of β-agonists used as growth promotants in the feedlot industry. It can also help in the understanding of the potential for interactions between the use of steroidal implants and β-agonists. This knowledge will aid in our ability to improve efficiency of lean tissue deposition in beef cattle.

Table 1. Effect of implant and Optaflexx on performance and carcass characteristics of feedlot heifers

	Treatment[1]			
Item	RF	RF+OPT	R200	R200+OPT
Pens	4	4	4	4
Number of heifers	274	271	274	272
Starting weight, lb	623	622	622	622
Dry matter intake, lb/day	16.92	16.90	17.19	16.77
Average daily gain, lb[a]	3.04	3.14	3.10	3.14
Feed:gain[a]	5.56	5.38	5.54	5.35
Hot carcass weight, lb[a]	758	771	764	772
Ribeye area, square inches[a]	14.46	14.84	14.60	15.02
12th rib fat, inches[a]	0.49	0.45	0.49	0.46
Marbling score[2]	425	409	406	398
Kidney, pelvic, and heart fat, %	1.97	2.00	2.01	2.03
Calculated final yield grade[a]	2.61	2.45	2.61	2.43

[a]Optaflexx effect, $P<0.05$.
[1]RF = Revalor-IH initially plus reimplant with Finaplix-H at 58 days, OPT = Optaflexx fed during final 28 days of trial, R200 = Revalor-200 at trial initiation.
[2]400 = Small.

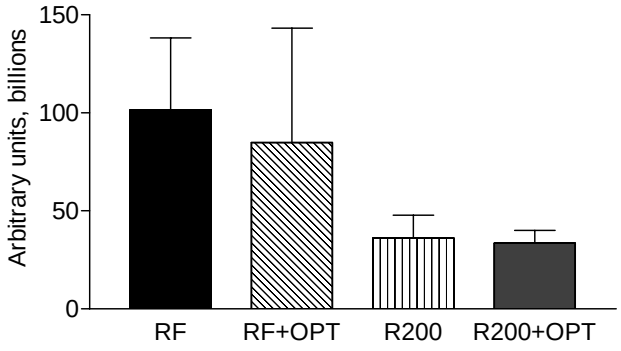

Figure 1. β1-adrenergic receptor mRNA relative abundance in semimembranosus muscle. RF = Revalor-IH initially plus reimplant with Finaplix-H at 58 days, OPT = Optaflexx fed during final 28 days of trial, R200 = Revalor-200 at trial initiation.

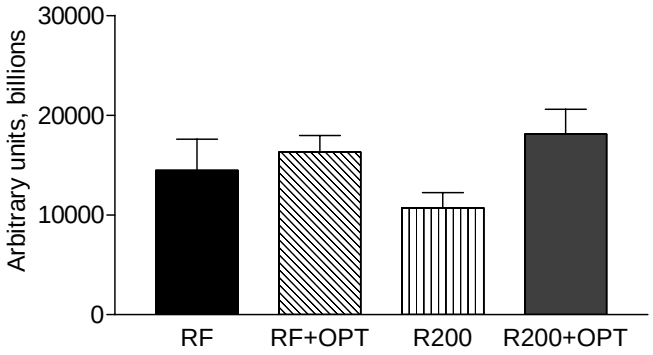

Figure 2. β2-adrenergic receptor mRNA relative abundance in semimembranosus muscle. RF = Revalor-IH initially plus reimplant with Finaplix-H at 58 days, OPT = Optaflexx fed during final 28 days of trial, R200 = Revalor-200 at trial initiation.

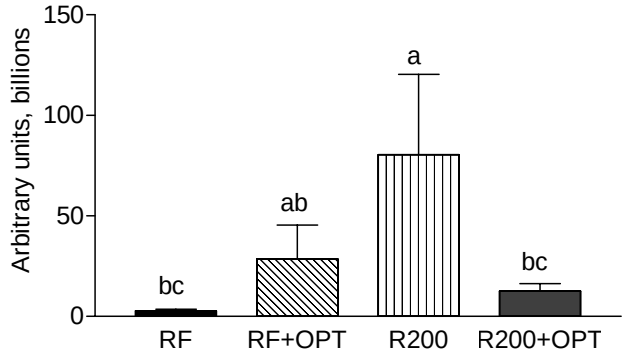

Figure 3. β3-adrenergic receptor mRNA relative abundance in semimembranosus muscle. Bars not bearing a common letter differ, P<0.05. RF = Revalor-IH initially plus reimplant with Finaplix-H at 58 days, OPT = Optaflexx fed during final 28 days of trial, R200 = Revalor-200 at trial initiation.

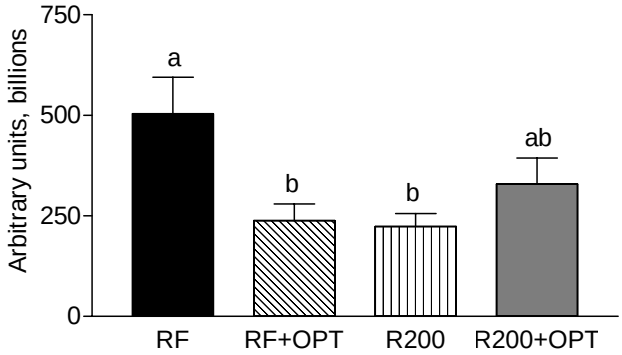

Figure 4. Insulin-like growth factor-I mRNA relative abundance in semimembranosus muscle. Bars not bearing a common letter differ, P<0.05. RF = Revalor-IH initially plus reimplant with Finaplix-H at 58 days, OPT = Optaflexx fed during final 28 days of trial, R200 = Revalor-200 at trial initiation.