Cattlemen's Day 2003

EFFECTS OF FLAX SUPPLEMENTATION AND A REVALOR-S IMPLANT ON CIRCULATING INSULIN-LIKE GROWTH FACTOR 1 (IGF-1) AND MUSCLE IGF-1 mRNA LEVELS IN FINISHING CATTLE

J. D. Dunn, J. P. Kayser, A. T. Waylan, E. K. Sissom, J. S. Drouillard, and B. J. Johnson

Summary

Sixteen crossbred steers weighing 875 lb were used to evaluate the effects of a 5% ground flaxseed supplement and a combined trenbolone acetate/estradiol (TBA/E_2) growth promoting implant, Revalor-S®, on both circulating insulin-like growth factor-1 (IGF-1) and local muscle IGF-1 mRNA concentrations. Steers were randomly assigned to one of four treatments: . 1) Flax/Implant, 2) No Flax/ Implant, 3) Flax/No Implant, 4) No Flax/No Implant. Serum was harvested from blood collected via jugular venipuncture on day 0 (before implantation or flax addition), 14, and 28. Muscle biopsy samples were obtained from the *longissimus* muscle on days 0, 14, and 28. Implanted steers had 52 and 84% higher ($P<0.05$) circulating IGF-1 levels than non-implanted steers on days 14 and 28, respectively. Cattle fed diets without flax had higher levels of muscle IGF-1 mRNA than cattle fed diets with flax on day 28 (4.4-fold, $P<0.01$). Our data support that the administration of a combined TBA/E_2 growth promotant increases circulating IGF-1 and local muscle IGF-1 mRNA concentrations in finishing cattle. However, this increase in muscle IGF-1 mRNA appears to be attenuated by the addition of a dietary flax supplement.

Introduction

Growth promoting implants containing both trenbolone acetate (TBA) and estradiol (E_2) are known to increase insulin-like growth factor-1 (IGF-1) levels in circulation as well as IGF-1 mRNA levels in the muscle of finishing cattle. IGF-1 is a very important growth factor for skeletal muscle growth because it stimulates muscle cell proliferation, differentiation, and protein synthesis. Flaxseed is a source of alpha-linolenic acid, which is an omega-3 polyunsaturated fatty acid. Additions of dietary omega-3 fatty acids have been shown to increase cell membrane fluidity, which may enhance the ability of IGF-1 to bind to its receptor in muscle tissue, thus potentiating IGF-1 actions in muscle. There is potential for additive or synergistic effects on muscle growth when growth promotants that increase both circulating IGF-1 and muscle IGF-1 mRNA concentrations are used in conjunction with feedstuffs high in omega-3 fatty acids. The objective of our study was to determine how circulating IGF-1 and muscle IGF-1 mRNA levels are affected by a 5% ground flaxseed supplement and administration of a combined TBA/E_2 implant, Revalor-S.

Experimental Procedures

Sixteen crossbred steers weighing 875 lb were stratified by weight and randomly assigned to one of four treatments: 1) Flax/Implant, 2) No Flax/Implant, 3) Flax/No Implant, 4) No Flax/No Implant. Steers were allowed ad libitum access to a 92% concentrate diet supplied once daily (Table 1). Serum was harvested from blood samples collected by jugular venipuncture on days 0 (before implantation and flax addition), 14, and 28 and were stored for subsequent analysis of circulating IGF-1. Muscle biopsy samples were obtained from the *longissimus dorsi* on

days 0, 14, and 28 using a Bergstrom biopsy needle. Total RNA was isolated from the muscle samples, and real-time quantitative polymerase chain reaction (PCR) was used to evaluate IGF-1 gene expression.

Results and Discussion

Flax supplementation had no significant effect on circulating IGF-1 levels in finishing steers (Figure 1). Implanted steers had 52 and 84% greater ($P<0.05$) circulating IGF-1 levels than their non-implanted counterparts on days 14 and 28, respectively (Figure 1). Cattle that were not supplemented with flax had higher (4.4 fold, $P<0.01$) levels of muscle IGF-1 mRNA on day 28 than those that received the flax supplement. On day 28, implanted steers had 2.4-fold higher ($P<0.01$) muscle IGF-1 mRNA levels than non-implanted steers (Figure 2). Our data was consistent with other research findings and demonstrates that the administration of a TBA/E_2 growth promotant, Revalor-S, increased circulating IGF-1 and muscle IGF-1 mRNA levels in finishing cattle.

Flax supplementation had no effect on circulating IGF-1 levels, and it led to lower muscle IGF-1 mRNA levels on day 28 (Figure 2). It is possible that the addition of flax to the diet increased the sensitivity of the muscle tissue to systemic IGF-1, which could, in turn, cause the level of muscle IGF-1 gene expression to be down-regulated. It is also possible that the alpha-linolenic acid in the flax supplement had direct effects on muscle IGF-1 gene expression. It is not possible to discern from our data whether dietary addition of flax has a direct or indirect effect on muscle IGF-1 mRNA levels. However, our data still offer useful information toward the ultimate goal of understanding how dietary additions of omega-3 fatty acids and the use of anabolic steroid implants impact muscle growth of finishing cattle.

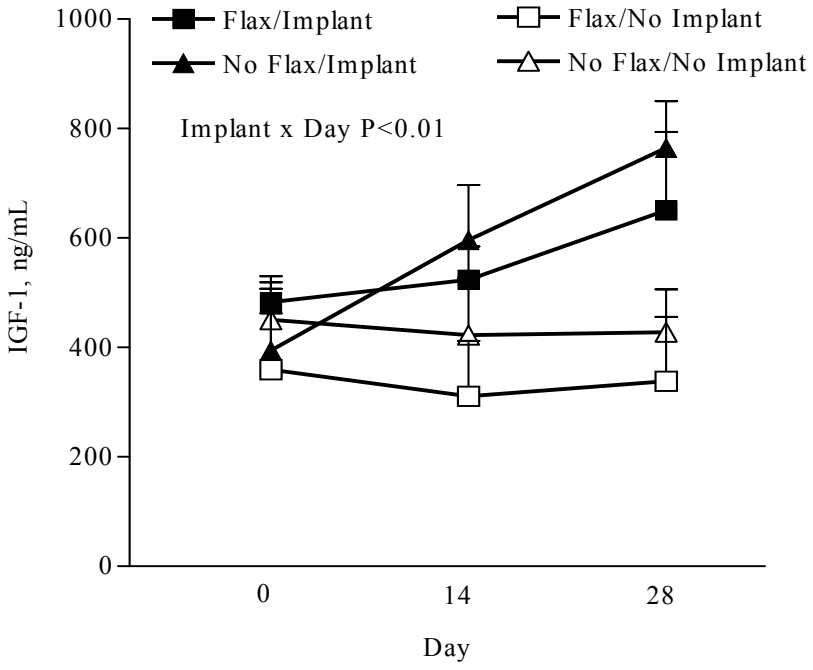

Figure 1. Effect of Flax Supplementation and a Revalor-S Implant on Circulating IGF-1 Levels of Finishing Cattle.

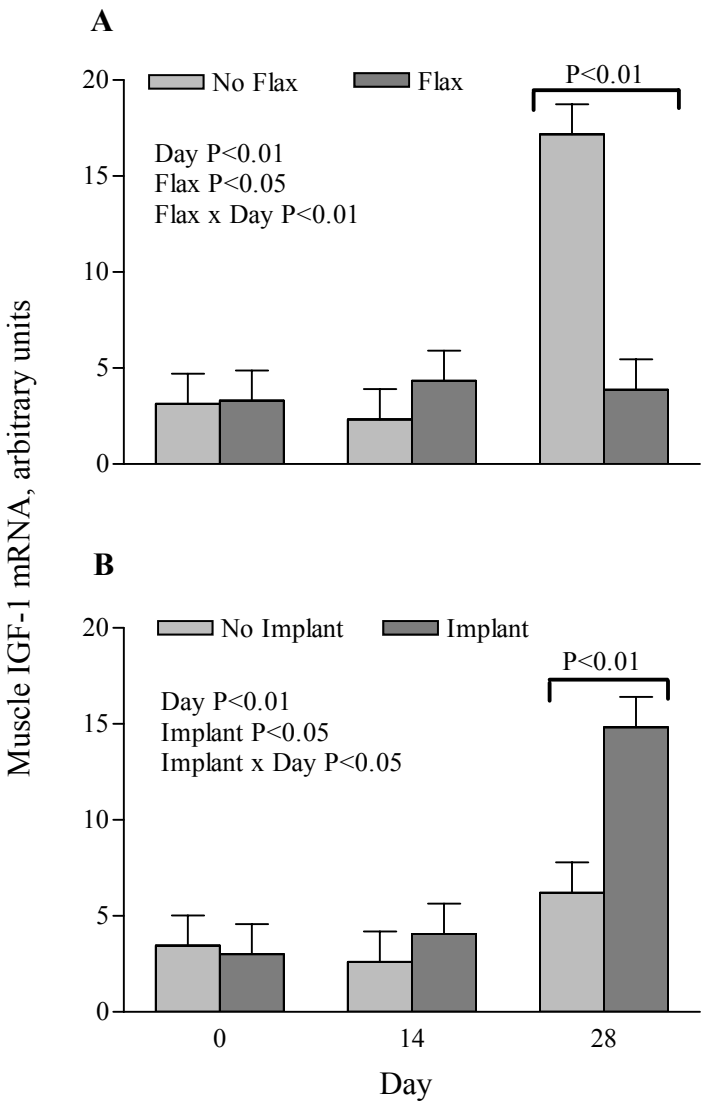

Figure 2. Effects of Flax Supplementation (Panel A) and a Revalor-S Implant (Panel B) on Muscle IGF-1 mRNA Levels of Finishing Cattle.

Table 1. Experimental Diets

Ingredient	Treatments	
	Flax	No Flax
	---------- % of Dry Matter ----------	
Steam-flaked corn	77.5	81.9
Corn steep liquor	5.9	5.9
Alfalfa hay	8.0	8.0
Flaxseed, ground	5.1	—
Vitamin/trace mineral premix[a]	3.6	4.2
	---------- lb per Steer Daily ----------	
Rumensin/Tylan premix[b]	0.5	0.5

[a]Vitamin/trace mineral premix formulated to provide (total diet dry matter): 1,500 IU/lb vitamin A, 835 IU/lb vitamin E, 0.2 ppm cobalt, 13 ppm copper, 75 ppm manganese, 0.30 ppm selenium, 75 ppm zinc, and 78 ppm iodine.
[b]Provided 300 mg Rumensin and 90 mg Tylan per steer daily.