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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

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Abstract

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/E2) 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/E2 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.

Keywords

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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

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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.

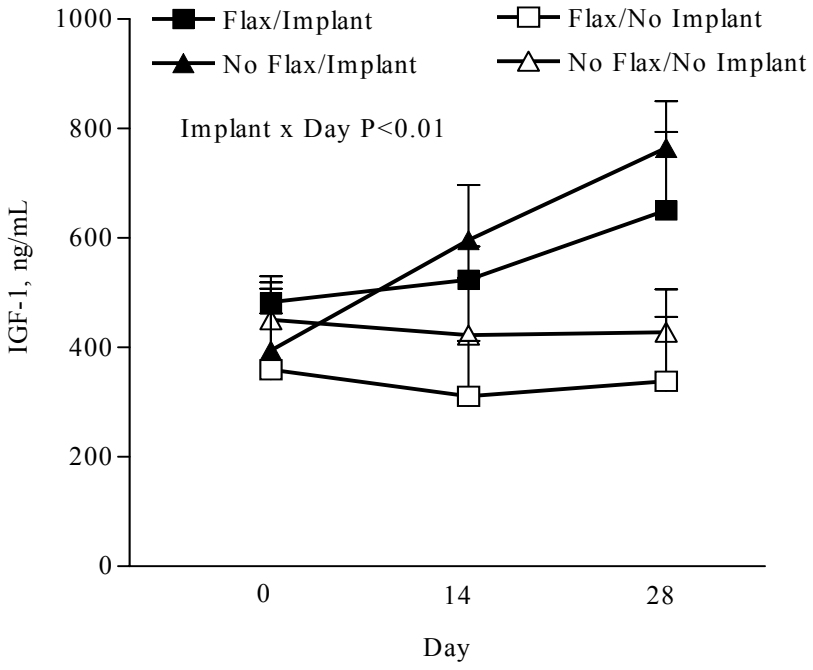

Figure 1. Effect of Flax Supplementation and a Revalor-S Implant on Circulating IGF-1 Levels of Finishing Cattle.

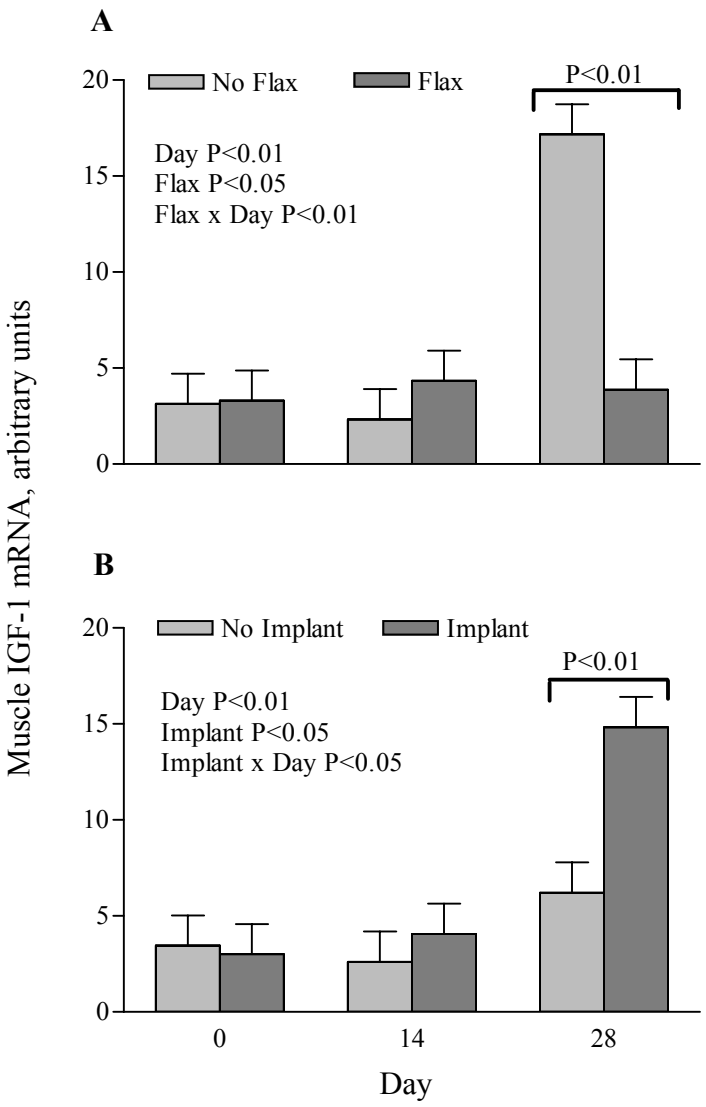

Figure 2. Effects of Flax Supplementation (Panel A) and a Revalor-S Implant (Panel B) on Muscle IGF-1 mRNA Levels of Finishing Cattle.

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.