IGF1 - A POOR INDICATOR OF GROWTH RATE IN DIFFERENT-SIZED ANGUS CATTLE

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SUMMARY

The relationship between plasma levels of IGF1 and daily growth rate was examined in young Angus cattle from 3 selection lines which differ in their genetic potential for growth to yearling age. Calves from the fast growth-rate line had IGF1-levels of 459 and 545 ng/mL at the first and second bleed (271 and 332 days of age) respectively, significantly higher ($P<0.05$) than those of the randomly-bred Control-line calves (425 and 436 ng/mL). Calves from the slow growth-rate line had a mean level of 475 ng/mL at the first bleed, comparable to that of the fast growth-rate line, and 472 ng/mL at the second bleed, similar to that of the Control-line. The failure to demonstrate consistent differences in IGF1 levels between these growth-rate selection lines and/or a close relationship between growth rate and IGF1 suggested that level of IGF1 was a poor physiological indicator of growth potential in these cattle.

INTRODUCTION

Livestock improvement based on selection for commercially important traits seldom results in annual rates of genetic gain greater than 3% (Smith 1984) of the mean. There has recently been considerable research effort into identifying indirect predictors of genetic merit that might enhance the rate at which genetic progress can be made. One of the key criteria for a physiological indicator trait to be useful in selection programmes must be a moderate to high accuracy of selection. This requires a strong genetic relationship between the indicator trait and the desired trait (Blair et al. 1990).

IGF1 (insulin-like growth factor-1) is of particular interest as a potential physiological indicator trait because it is secreted in a non-pulsatile manner and appears to be involved in the genetic regulation of growth (Blair et al. 1990). In this paper the relationship between plasma levels of IGF1 and daily growth rate is examined in young Angus cattle from 3 lines which differ in their genetic potential for growth to yearling age.

MATERIALS AND METHODS

The cattle came from 3 lines of Angus cattle selected since 1974 for either fast daily weight gain from birth to yearling age (the High-line), slow daily weight gain over the same period (the Low-line) or from an unselected Control-line (Parnell et al. 1991). The entire drop of calves born in 1986 were used in this study. Male claves were stratified on age and 25% from each line castrated when 3 months old. All calves were weaned in January 1987 at about 6 months of age. Following weaning the bull and heifer calves grazed good quality pasture, with the bull calves receiving some supplementary grain feed. The steers were lot-fed a high-quality pelleted ration.

The cattle were weighed and first bled 9 weeks after weaning and again 9 weeks later. Single blood samples were taken on each occasion as previous work on cattle has shown that IGF1 is not released into the blood in a pulsatile fashion and shows little diurnal variation (Breier et al. 1986). The cattle

were bled in the morning and within 3 hours of last feeding. Blood samples were stored on ice before being centrifuged, the plasma frozen and their IGF1 content determined using radioimmunoassay (Bass et al. 1989). The calves were also weighed at 1 year of age. Daily growth rates were calculated by subtracting birthweight and dividing by age.

The amount of variation in daily growth rate and plasma IGF1-levels explained by differences between lines and sex of calf was analysed using a general linear model (GLM) procedure. The number of calves of each sex differed between the lines making the design unbalanced. Results are therefore reported as least-squares means (LS-means)±se. The repeatability of IGF1 levels between bleeds, and the amount of variation in growth rate explained by level of IGF1, were measured using the correlation coefficient (r^2) obtained using regression procedures. Variation in growth rates to yearling age explained by growth rates and IGF1 levels at younger ages were examined using the GLM procedure.

RESULTS AND DISCUSSION

The calves were 271±1 days old when first bled and 332+1 days old when bled the second time. There was no significant difference in age between calves from each line and sex at each bleed. Calves from the High-line grew to both bleeds and to yearling age faster than calves from the Control-line, who in turn grew faster than the calves from the Low-line (Table 1). Heifer calves grew more slowly than bull and steer calves. The steers grew faster than the bull calves to the first bleed and to yearling age but not to the second bleed.

Table 1. Daily growth rates of Angus calves from birth to the first bleed at 271 days of age, the second bleed at 332 days of age, and to 1 year of age, and plasma levels of IGF1 at the first and second bleeds. Values are LS-means±se. Means for lines or for sex with different superscripts differ significantly (P<0.05)

	Growth rate (g/d) to:			IGF1 (ng/ML) at:	
	First bleed	Second bleed	Yearling age	First bleed	Second bleed
High-line (N=116)	819±8^a	799±8^a	755±7^a	459±10^a	545±15^a
Control-line (N=60)	720±10^b	704±9^b	668±9^b	425±13^b	436±19^b
Low-line (N=79)	622±9^c	597±9^c	567±8^c	475±12^a	472±17^b
Heifers (N=138)	592±7^a	592±6^a	567±5^a	270+9^a	282±12^a
Bulls (N=87)	765±9^b	763±8^b	681±7^b	478±11^b	569±16^b
Steers (N=30)	803±12^c	746±11^b	742±11^c	612±17^c	603±22^b

Plasma IGF1-levels were lower (P<0.01) at the first bleed (451±9 ng/mL) than at the second (486±9 ng/mL). The slight increase in IGF1-levels with age has also been observed in other studies on calves and sheep (Bass et al. 1989; Kerr et al. 1991; Speck et al. 1990a). The repeatabilities for the level of IGF1 measured in the same animal between the first bleed and the second bleed were 0.52, 0.33, 0.53 and 0.46 for the calves from the High, Control, and Low-lines, and the 3 lines together (all were significant; P<0.001).

High-line calves had high levels of IGF1 at both bleeds, significantly higher ($P<0.05$) than those of the Control-line calves (Table 1). The Low-line calves had IGF1 levels at the first bleed, comparable to those of the High-line, and lower levels at the second bleed, similar to those of Control-line. The heifer calves had lower levels of IGF1 than either of the other 2 sexes at both bleeds. Steers had significantly higher levels of IGF1 than bull calves at the first bleed ($P<0.001$) but not at the second bleed.

The lack of a consistent difference in plasma IGF1-levels between calves from the High-line and the Low-line was also observed in another experiment using 1-year-old Trangie steers (Speck et al. 1990b). Two studies of lines of sheep selected for different weaning weights have been reported. In the USA, Medrano and Bradford (1991) failed to find a significant difference in plasma IGF1 concentrations between their selection lines of Targhee sheep, whereas Speck et al. (1989) examining Merino sheep in NSW did. Differences in the IGF1 levels between sexes in the present study were confounded with differences in feed quality on offer to each sex, both of which have previously been associated with differences in IGF1-levels in young cattle (for sex: Bishop et al. 1989; Kerr et al. 1991; for nutrition: Breier et al.1986; Anderson et al. 1988; Bass et al. 1989).

For all the calves considered together, the amount of the variation in growth rates explained by plasma IGF1-levels was 34% for growth to the first bleed, 48% for growth to the second bleed, and 27 and 44% for growth to yearling age by IGF1 measured at the first and second bleed respectively (all were significant; $P<0.01$). Within each line, the amount of variation in growth rate explained by plasma IGF1-levels was 35 to 62% (Table 2). However these r^2-values did not reflect a close relationship between growth and IGF1-levels. Rather they were associated with differences between the sexes, with the heifer calves generally having low levels of IGF1 and slow growth rates, and the steers having high levels of IGF1 and high growth rates. For calves of each sex, the amount of variation in growth rate explained by plasma IGF1-levels was much less, ranging from only 1% to 32% despite a wide range of growth rates being present within each sex.

Table 2. *Correlation co-efficients for daily growth rates of Angus calves versus plasma levels of IGF1* for growth from birth to the first bleed, second bleed and to 1 year of age. Values are r^2 with an asterisk indicating where IGF1-level explained significant ($P<0.05$) variation in growth rate.

	First Bleed	Second Bleed	Yearling growth v IGF1 at: First bleed	Second bleed
High-line	0.56*	0.62*	0.54*	0.58*
Control-line	0.60*	0.58*	0.56*	0.41*
Low-line	0.44*	0.35*	0.36*	0.38*
Heifers	0.07*	0.10*	0.05*	0.08*
Bulls	0.03	0.32*	0.02	0.32*
Steers	0.02	0.03	0.05	0.01

For all the calves considered together, the amount of variation in growth rate to yearling age explained by liveweights taken at younger ages was 88% for weights taken at the first bleed and 87% for weights at the second bleed (both significant; $P<0.001$). The additional variation explained by plasma IGF1-levels measured at these ages was less than 0.2% and not significant. Clearly, in selection programmes based on growth rate, plasma IGF1-levels would add nothing to the accuracy of selection above that

achieved by simply weighing the animals. Several studies on young cattle have now failed to demonstrate a strong correlation between IGF1 levels and growth rate (Bishop et al. 1989; Davis and Bishop 1991; Kerr et al. 1991). The failure to find consistent differences between the lines examined in this study, lines with genetically different rates of growth, suggests that IGF1 is a poor indicator of growth potential in these cattle.

At the same age there are no significant differences between the Trangie lines in the percentage of fat, muscle or bone in the carcass (Parnell et al. 1991) and this might explain the failure to find consistent differences in IGF1 levels between the lines. IGF1 has been shown to have a positive association with other economically-important traits including carcass leanness (Anderson et al. 1988) and feed conversion efficiency (Bishop et al. 1989) in cattle, and growth of lean tissue in sheep (Oddy et al. 1991), and may yet prove to be a useful physiological indicator trait in selection programmes.

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