EFFECTS OF ZERANOL ON SKELETAL GROWTH OF CULL COWS AND HEIFERS

Thirty-two cull cows aged from 1 to 13 yr were allocated to five age groups and fed individually for 82 days, then slaughtered. Half of the cows within each group were implanted with 36 mg of zeranol. Zeranol had no significant effect on average daily gain, feed efficiency or backfat thickness, but caused a decrease in radio-ulna mass ($P = 0.10$) and length ($P = 0.03$). Rate of bone growth at the distal end of the radio-ulna decreased with increasing age to 0 at 4–5 yr.

Key words: Cattle, bone growth, zeranol, cull cows, feedlot performance, carcass traits

[Effets du zéranol sur la croissance du squelette de vaches et de génisses de réforme.]
Titre abrégé: Zéranol et croissance des os chez les vaches de réforme.
Nous avons réparti 32 vaches de réforme âgées de 1 à 3 ans en cinq groupes d'âge et les avons nourries individuellement pendant 82 jours avant de les abattre. La moitié des sujets de chaque groupe avaient reçu un implant de 36 mg de zéranol. La croissance des os a été contrôlée par marquage à l'oxytétracycline des plaques de croissance de l'épiphyse. Le zéranol n'a pas eu d'effet significatif sur le gain moyen quotidien, sur l'indice de transformation ni sur l'épaisseur de gras dorsal mais il a provoqué une baisse de la masse radiocubitale ($P = 0,10$) et une diminution de la longueur ($P = 0,03$). Le taux de croissance à l'extrémité distale du radius et du cubitus a diminué avec l'âge, pour devenir nul vers l'âge de 4 ou 5 ans.

Mots clés: Bovin, croissance des os, zéranol, vaches de réforme, rendement en porc d'engraissement, charactéristiques de la carcasse.

Carcass growth is a function of bone, muscle and fat growth, a superior carcass being one with maximum muscle, minimum bone and optimum fat for the particular market being supplied. Zeranol, a resorcylic acid lactone used commercially as a growth stimulant, has been found to have no influence on carcass muscle and fat characteristics of cattle (Price and Makarechian 1982). However, Staigmiller et al. (1983) suggested that the substance may increase the pelvic opening in heifers, suggesting an influence on bone growth. This would have commercial importance by changing the ratio of edible to non-edible portions of the carcass. The following experiment investigated the effect of zeranol in the form of the commercial implant Ralgro® (I.M.C.: Terre Haute, Ind.) on the growth of the radio-ulna bones of five groups of cull cows ranging in age from 1 to 13 yr to establish the nature and extent of any influence of zeranol on skeletal growth.

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A total of 32 cull cows and heifers from the University of Alberta herd, born in April and May, were selected from females culled for inferior reproductive performance. Cows were categorized as beef-type or dairy-type, and subjectively scored for fatness. They were then divided into five age groups: less than 2 yr, 2–3 yr, 3–4 yr, 4–5 yr and more than 5 yr old. Within each age group they were selected to give equal numbers of beef- and dairy-types, and the fattest and thinnest cows were excluded. Half of the cows in each age group were implanted with 36 mg of zeranol and all the cows were infused intravenously with oxytetracycline (15 mg/kg body weight) on day 1 of the experiment to label the epiphyseal growth plates (Graham and Price 1981). The cows were placed in individual pens and fed a high energy diet containing 60% grain (rolled barley:rolled oats, 3:1), 35% hay and 5% of a protein-vitamin-mineral supplement at the rate of 120 g feed/$kg^{0.73}$ of body weight. The cows were weighed and

feed allowance was recalculated weekly. Following 82 days of feeding the cows were slaughtered and both fore-shanks were removed by a cut above the elbow (radio-ulna to humerus) joint. The shanks were trimmed of tissue distal and proximal to the radio-ulna and then dissected. Length, circumference and specific gravity of the radio-ulnae were recorded as outlined by Jones et al. (1978) and they were then split longitudinally and photographed under ultraviolet light to measure linear growth in the 82 days since infusion of oxytetracycline. Data were analyzed for the effects of treatment, age and their interaction by least squares analysis of variance (Harvey 1977).

There were no statistically significant treatment × age interaction effects for any of the traits analyzed. Zeranol had no significant effect on average daily gain (Table 1). This agrees with the results of Price and Makarechian (1982) though they reported an interaction between age and zeranol treatment for average daily gain. There was no effect of Zeranol on feed efficiency or backfat thickness. Age had a variable effect on growth and efficiency. The 1- to 2-yr-old heifers had 7–9 mm backfat which was less ($P<0.05$) than the 14.5-mm average of the other cows. The shank dissection indicated that the zeranol-treated cows had a greater muscle:bone ratio than the non-treated cows ($P=0.08$). The treatment effect on muscle:bone ratio was more likely to be a result of lighter bone weight in the treated cows ($P=0.10$) than heavier muscle weight ($P=0.77$). Zeranol had no effect ($P=0.17$) on the amount of fat dissected from the shank; however, the oldest cows (>5 yr) had more dissectable fat ($P<0.05$) than the heifers (1–2 yr). There was no effect of age on shank muscle to bone ratio, but there was a significant increase in both muscle and bone weight with age.

The length of the radio-ulna was less ($P=0.03$) in zeranol-treated cattle than controls (Table 1). However, no significant effect of zeranol treatment on growth rate during the 82 days before slaughter could

Table 1. Least squares means and standard errors for the traits studied in 32 cull cows and heifers†

	Treatment			Age groups (years)					
	Zeranol	Control	Probability	1–2	2–3	3–4	4–5	>5	Probability
No. of animals	16	16		6	8	6	6	6	
ADG (kg)	1.06±0.05	1.14±0.05	$P=0.24$	1.08*ab*±0.08	1.08*ab*±0.07	1.13*ab*±0.08	1.29*a*±0.08	0.92*b*±0.08	$P=0.04$
Feed/kg wt gain (kg)	10.88±0.71	11.04±0.71	$P=0.87$	7.25*a*±1.15	10.65*b*±0.99	11.93*c*±1.15	9.70*b*±1.15	15.28*d*±1.15	$P=0.01$
Backfat (mm)	13.7±0.8	12.7±0.8	$P=0.42$	7.9*a*±1.4	14.3*b*±1.2	14.6*b*±1.4	14.5*b*±1.4	14.5*b*±1.4	$P=0.01$
Slaughter wt (kg)	511±6.6	517±6.6	$P=0.52$	322*a*±10.7	480*b*±9.3	528*c*±10.7	586*d*±10.7	651*e*±10.7	$P<0.01$
					Shank dissection				
Muscle wt (kg)	1.832±0.035	1.818±0.035	$P=0.77$	1.250*a*±0.057	1.808*b*±0.050	1.945*bc*±0.57	2.011*c*±0.057	2.111*c*±0.057	$P<0.01$
Bone wt (kg)	1.112±0.020	1.160±0.020	$P=0.10$	0.800*a*±0.033	1.36*b*±0.028	1.237*b*±0.033	1.164*b*±0.033	1.342*c*±0.033	$P<0.01$
Fat wt (kg)	0.455±0.028	0.399±0.028	$P=0.17$	0.272*a*±0.046	0.419*b*±0.039	0.380*ab*±0.046	0.515*b*±0.046	0.551*b*±0.046	$P<0.01$
Muscle:bone ratio	1.647±0.027	1.579±0.027	$P=0.08$	1.575±0.044	1.592±0.038	1.585±0.044	1.728±0.044	1.583±0.044	$P=0.08$
					Radio-ulna measurements				
Length (mm)	385.5±1.9	391.4±1.9	$P=0.03$	346.0*a*±3.1	388.7*b*±2.7	401.6*c*±3.1	398.0*c*±3.1	407.9*c*±3.1	$P<0.01$
Circumference (mm)	125.0±1.3	126.7±1.3	$P=0.37$	110.3*a*±2.1	126.5*b*±1.8	130.2*bc*±2.1	127.9*bc*±2.1	134.4*c*±2.1	$P<0.01$
Linear growth at the distal end (mm/82 days)	2.7±0.2	2.8±0.2	$P=0.74$	9.8*a*±0.3	3.4*b*±0.3	0.4*c*±0.3	0.00*c*±0.3	0.00*c*±0.3	$P<0.01$
Specific gravity	1.445±0.15	1.427±0.015	$P=0.35$	1.367*a*±0.024	1.422*ab*±0.021	1.488*b*±0.24	1.457*b*±0.024	1.484*b*±0.024	$P=0.01$

†No significant treatment × age interaction was found for any of the traits analyzed.
*a–e*Means followed by different letters are different ($P<0.05$).

be detected by the oxytetracycline method. Zeranol had no effect on the circumference or specific gravity of the radio-ulnae. The treatment differences in bone length and weight may have been caused by zeranol binding with the estrogen receptors in the epiphyseal growth plates and invoking a similar response to that of naturally occurring estrogens as suggested by Katzenellenbogen et al. (1979). It is known that estrogens reduce linear bone growth and hasten closure of epiphyseal growth plates (Silberberg 1972).

The length and circumference of the radio-ulna were affected by age ($P<0.01$) up to 3–4 yr (Table 1), after which no difference in length was evident. The rate of growth detected at the distal end of the radius confirmed that active growth was occurring in the 1 to 2 and 2- to 3-yr-old females, that some growth was occurring in the 3- to 4-yr-old group and that no growth was occurring at this site in the two oldest groups. The radio-ulna grows at four separate epiphyseal plates, corresponding to one plate each at the distal and proximal ends of the radius and the ulna. The distal radius plate was reported by Sisson and Grossman (1964) to ossify at approximately 39–48 mo of age which corresponds to the present results. The rates of growth found at the distal radius in the present experiment also confirm those reported by Graham and Price (1981). The specific gravity of the radio-ulna bones was significantly less in the youngest group than in the three oldest groups. Jones et al. (1978) reported an increase in bovine radio-ulna density during the first 2 yr.

It is concluded that zeranol has an inhibitory effect on the growth of the radio-ulna bone in the young cows, which may be sufficient to alter the fore-shank muscle to bone ratio. Further study of this phenomenon is warranted.

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