Pre-Weaning Growth Of Large And Small Scale Beef Calves

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Story in Brief

Pre-weaning rate of growth and maturity of eight small scale (Angus) and eight large scale (Charolais) calves was studied. Data utilized for evaluating rate of growth was obtained from skeletal linear measurements and radiographs of the left metacarpal.

Results indicated a significant ($P<.01$) difference in the growth rate of these two groups of calves with the small scale group (Angus) being smaller. Metacarpal radiogram data indicated that the small scale calves reached physiological maturity during the pre-weaning phase of their lifetime. However, these data suggest that physiological maturity in the large scale calves is not attained until the post-weaning life phase. The difference in the time at which physiological maturity is attained could have important economical considerations. It would appear that whereas the large scale calves are normally placed in a dry lot at the same age as the small scale calves, they are still immature in skeletal development. Also, the smaller scale beef breeds may well be suited for placing in a feedlot earlier than is the current practice from an economical standpoint.

Introduction

For many years, a primary goal of animal scientists has been to selectively breed and produce meat animals with the ability to grow rapidly and deposit large percentages of "quality" lean tissue as efficiently as possible. Much effort has been expended in the measurement and evaluation of gross indices such as weaning weight, average daily gain, ribeye area, etc. These estimators of genetic breeding potential have certainly contributed to the improvement of the livestock industry. Consequently, considerable research effort has been directed to the performance of the live animal after weaning with little study of the life span from birth to weaning. With the recent introduction of the fast growing "exotic" breeds, questions have arisen as to the validity of these measurements when applied to breeds of different growth rates and rates of maturity.

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The purpose of this study was to determine certain physiological changes relating to the growth and development of an "early" or "fast" maturing, small scale bovine breed and a "later" or "slower" maturing, large scale breed from immediately after birth to weaning.

Materials and Methods

The experimental animals for this study were eight grade Angus steer calves and eight Charolais cross (7/8 Charolais x 1/8 Angus) steer calves. Skeletal measurements were obtained at four stages of growth from birth to weaning. Skeletal measurements were: 1) body depth, measured from topline to sternum parallel to the 5th rib; 2) thickness of forequarter, measured between the lateral surfaces of the shoulders; 3) thickness of hindquarter, measured between the lateral surfaces of the round; 4) thickness of rump, measured between the lateral surfaces of the tuber coxae; 5) length of rump, measured by the distance from the anterior surface of the tuber coxae to the posterior surface of the tuber ischii; 6) depth of forequarter, measured from the proximal surface of the cartilage of the scapula to the olecranon; 7) body length, measured along the topline of the animal from the proximal anterior point of the scapula to the posterior surface of the tuber ischii; and 8) length of side measured from the anterior surface of the lateral tuberosity of the humerus to the anterior point of the tuber coxae.

All skeletal measurements were accomplished in duplicate. Live weight at each evaluation period was also obtained on each animal. In addition, the left metacarpal of each animal was radiographed at the OSU Veterinary Medicine Radiology Laboratory in order to evaluate bone development and maturity.

The Angus calves averaged 41 days of age and the Charolais calves 32 days of age at the first evaluation period. Periods 2, 3, and 4 were subsequent evaluation periods of 56 day intervals for both groups.

Results and Discussion

The analysis of the data presented in this study is derived from values obtained at a specific period in the lifetime of the individual. However, in analyzing any growth pattern one must keep in mind that the pattern of growth is not composed of point-to-point changes, but is a continued balance of gain and loss of total animal mass. This pattern is normally linear during the earlier, more rapid phase of growth followed by a curvilinear pattern as maturity is approached. A change from a linear to a curvilinear growth curve may then be used to estimate differing rates of maturity between the breeds of differing rates of maturity.

The statistics of variation utilized in this analysis were breed variation and period variation as the main effects, as well as a breed x period interaction. Table 1 presents the tests of significance utilized for live weight and the eight skeletal measurements. It is apparent that there was no significant (<.05) breed difference between the Angus group and the Charolais group from birth to weaning when analyzed for the variable, live weight. There was a significant (P<.01) period effect and breed x period interaction for live weight during this span of the calves lifetime.

This difference in growth rate may best be illustrated by Figure 1. The curves in Figure 1 reflect the change in live weight of the two breeds through the first 168 days on this study (pre-weaning phase). As noted, Period 1 represents the initial evaluation of the animals followed by three subsequent evaluations in 56 day increments, referred to as Periods 2, 3 and 4. During the first 56 days on trial (Period 1 to Period 2), the Angus calves increased in live weight from 53.81 kg. to 91.17 kg., a total increase of 37.36 kg. During this same length of time, the Charolais calves in-

Table 1. Mean Values for Linear Measurements and Radiogram Analysis by Period

Variable	Breed	Period 1[1]	2[2]	3[2]	4[2]
Live Weight[4]	A[3]	53.81	91.17	135.91	169.53
	C[3]	52.56	93.84	153.32	211.15
Body Depth[5]	A	30.91	38.26	42.98	46.36
	C	31.50	38.53	45.23	50.41
Thickness of Forequarter[5]	A	25.30	29.05	32.34	34.47
	C	22.61	26.92	31.52	36.20
Thickness of Hindquarter[5]	A	27.42	32.42	36.39	39.17
	C	27.05	32.55	39.26	43.62
Thickness of Rump[5]	A	18.38	22.94	27.15	30.13
	C	18.41	23.04	31.88	32.27
Length of Rump[5]	A	23.25	27.73	31.35	33.81
	C	24.67	29.61	34.27	41.87
Length of Topline[5]	A	60.36	76.31	86.92	95.54
	C	63.99	78.71	89.21	99.47
Length of Side[5]	A	47.20	56.32	66.01	72.14
	C	50.66	60.28	69.79	79.40
Depth of Forequarter[5]	A	27.03	31.86	35.76	39.37
	C	29.58	34.12	39.79	43.46
Metacarpal Length[5]	A	14.49	16.28	17.01	17.20
	C	17.02	18.05	19.08	20.22
Metacarpal Area[6]	A	40.20	49.42	57.59	59.02
	C	49.44	55.25	60.97	72.29

[1] Average age of Angus = 41 days; Charolais = 32 days
[2] Increments of 56 days between Periods
[3] A = Angus; C = Charolais
[4] Expressed in kg.
[5] Expressed in cm.
[6] Expressed in cm.^{2}

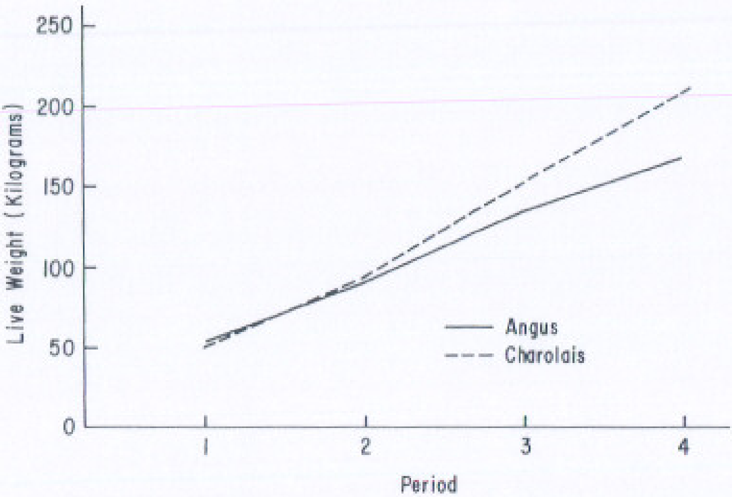

Figure 1. Mean Live Weight by Period

creased in live weight from 52.56 kg. to 93.84 kg. or a gain of 41.28 kg. Thus, the Charolais calves out gained the Angus calves by 3.92 kg. during this time. Between Periods 2 and 3, the Charolais gained a total of 59.48 kg. as compared to 44.74 kg. for the Angus, a plus of 14.74 kg. in favor of the faster growing Charolais. Between Periods 3 and 4, the Charolais out gained the Angus by 24.21 kg. Overall, during the first 168 days, the mean live weight for the Angus and Charolais was 112.61 kg. and 127.72 kg. respectively. This, however was not significant at the 5 percent level of probability.

Obviously, the period variation is significant ($P<.01$). In analyzing the rate of growth of the two groups it may be noted that the Charolais group exceeded the Angus at each period (after Period 1), with each period difference in live weight being successively larger than the previous period (i.e. 3.92 kg., 14.74 kg., and 24.21 kg. for Periods 2, 3 and 4 respectively). This steady increase in live weight in favor of the Charolais created the significant ($P<.01$) breed x period interaction illustrated in Table 2. This interaction indicates that while both breeds are increasing in live weight, the faster growing Charolais are increasing at a more rapid rate than the slower growing Angus.

While live weight may be used as one criteria for studying patterns of growth, it would also be useful to know if there are differences in patterns of growth within the skeletal structure of the animal. The eight skeletal measurements previously mentioned were analyzed using the

Table 2. Tests of Significance for Variable Live Weight

Source	df	Sum of Squares	Mean Square	F Value
Breed	1	35511.13	35511.250	3.94
Animal (Breed)	14	126146.75	9010.482	
Period	3	1675626.63	558542.208	2033.66**
Animal x Period (Breed)	42	11535.25	274.649	
Breed x Period	3	43951.13	14650.375	53.34**
Animal x Breed (Period)	42	11535.25	274.649	

** Significant ($P \leq .01$)

same statistics of variation as for live weight. Data in Table 3 represent a summary of the significance levels for each variable. The same explanation as to significance of the main effects and the interaction presented above for live weight is applicable to these linear measurements.

Table 1 contains a summary of the mean values for all linear measurements. From this data one may analyze differences in development of the skeletal structure between the two breeds and how and when they may differ. No effort will be made at this time to plot the linear and curvilinear phases of the various growth patterns due to the limited data presently available.

In summarizing the linear measurement data in Tables 1 and 3, it is apparent that there was a significant ($P<.01$) period effect for all variables studied. Also, there was a significant ($P<.01$) breed effect for three variables, length of rump, depth of forequarter, and length of side. The breed x period interaction, previously discussed, was significant ($P<.01$) for all variables except thickness of rump, length of topline, and depth of forequarter. Depth of forequarter was significant at the 5% level of probability, however. It is interesting to note that there was a significant ($P<.01$) breed and period effect for length of rump, but no interaction. Also, the thickness of rump and length of topline showed only a significant period effect. From these data, one would surmize that while there are evident differences in the growth rate between these two breeds from birth to weaning, the basic measures of scale (i.e. width and length) show similar trends of skeletal development.

While body weight and skeletal development provide visible and physical estimators of rate of growth, another index that may be even more precise is X-ray observation of a specific bone. From this type of observation, the actual time at which long bone growth occurs as well as the amount of long bone growth may be determined. For this study, radiogram data were obtained on the left metacarpal of each animal at each period of evaluation in order to estimate physiological maturity, in

Table 3. Summary of Significance Levels of Skeletal Measurements and Radiogram Analysis

Variable	Statistic of Variation		
	Breed	Period	Breed x Period
Live Weight	ns	**	**
Body Depth	ns	**	**
Thickness of Forequarter	ns	**	**
Thickness of Hindquarter	ns	**	**
Thickness of Rump	ns	**	ns
Length of Rump	**	**	ns
Length of Side	**	**	**
Depth of Forequarter	**	**	*
Length of Topline	ns	**	ns
Length of Metacarpal	**	**	**
Area of Metacarpal	**	**	**
Metacarpal Length	**	**	**
Metacarpal Area	**	**	**

ns = Non-Significant ($P > .05$)
* = Significant ($P < .05$)
** = Significant ($P < .01$)

addition to bone growth. The two variables selected for analysis were metacarpal length and metacarpal area. These results are presented in Figures 2 and 3 and Tables 1 and 3. The same statistics of variation dis-

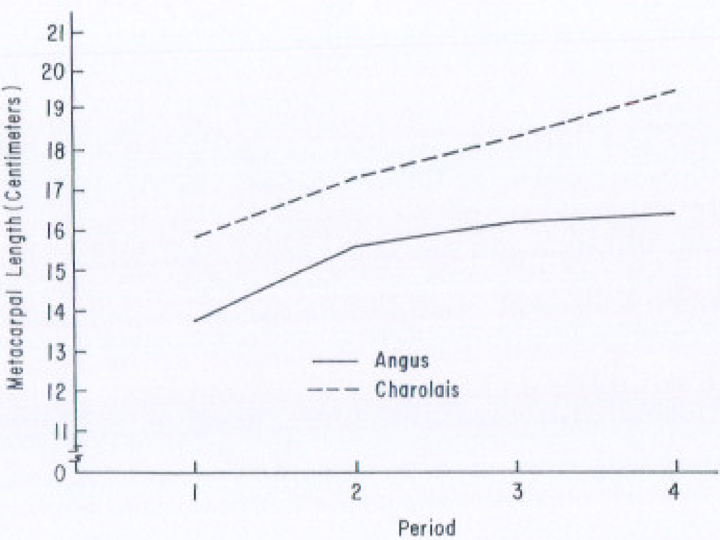

Figure 2. Mean Metacarpal Length by Period

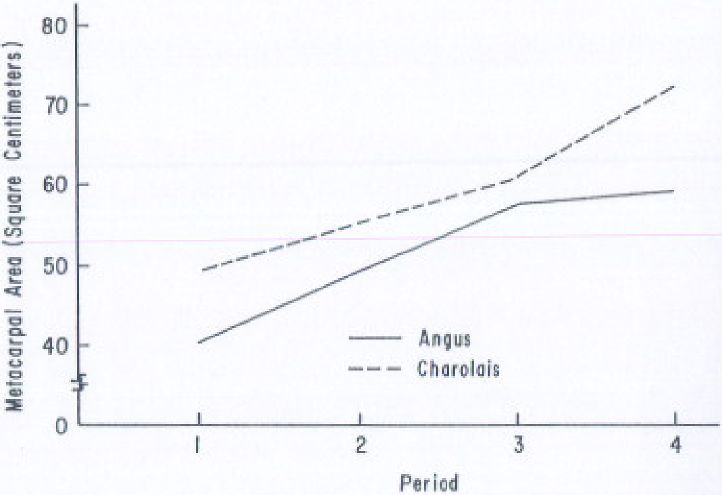

Figure 3. Mean Metacarpal Area by Period

cussed above were utilized for the radiogram data. It is apparent from the data plotted in Figure 2, that the change from a linear growth pattern to a curvilinear pattern has already occurred within the Angus group. This response is not apparent in the Charolais group, which appears to be still linear. Data available indicates that the Angus group has approached physiological maturity, at least for this particular variable. This apparently occurred sometime between 154 and 210 days of age. The results for the Angus calves seem to be in agreement with Guenther *et al.*, (1965) who reported that Hereford beef calves at seven months of age had already reached 87 percent of their final size. However the Charolais calves apparently mature later according to the present results.

Analysis of metacarpal area (Table 1) and rate of growth (Figure 3) reflect a similar pattern of growth through Period 3 with the Angus growing in total bone area at a more rapid rate than the Charolais. A definite leveling response is observed between Periods 3 and 4 along with a converse rapid increase in area for the Charolais. In comparing the slope of the growth curve for the Angus between Periods 2 and 3 for both length and area, it may be seen that while the length slope is decreasing, the area slope is not; therefore this bone appears to be growing in area faster than in length. The slope between Periods 3 and 4 are almost identical. Now, a similar slope is noted in the Charolais group for Periods 1 to 3 for both area and length. However, the area slope is much greater than the length slope between Periods 3 and 4. From this one may postulate that a decline in bone growth might be noted in the early "feedlot" phase of this study.

Literature Cited

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Performance Of Three-Year-Old Hereford, Hereford x Holstein And Holstein Females As Influenced By Level Of Winter Supplement Under Range Conditions

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Story in Brief

The productivity of winter-calving, 3-year-old Hereford, Hereford x Holstein and Holstein females under tallgrass range condition was compared. Two levels of supplementation (Moderate and High) were imposed on groups within each breed at calving and extended through the rest of the winter. An additional level of supplementation (Very High) was fed to a group of Holstein females.

As level of supplementation increased, winter weight loss decreased except for the Herefords. Cows in each group regained their winter weight loss the following summer except the Moderate Holsteins. Condition scores followed trends similar to winter weight losses and summer gains. Daily milk yield for the Hereford, Hereford x Holstein and Holsteins females was 14.0, 21.7 and 28.8 lb/day, respectively. Birth weights

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