

## CARCASS TRAITS: IMPACT OF RATE OF GAIN

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### Story in Brief

Feedlot performance from a total of 2771 feedlot steers fed in OSU research trials over the past 12 years was compiled to determine the relationship between specific carcass measurements and rate of gain during the feeding period. Ribeye area continued to increase as rate of gain increased to 4.5 lb live weight gain per day. As rate of gain increased, fat thickness over the rib, kidney-heart-pelvic fat and marbling increased at decreasing rates. Both dressing percentage and cutability decreased as rate of gain increased, but as hot weight was greater for faster gaining cattle, total weight of lean cuts increased. No indication of a plateau in lean deposition was noted though lean cuts as a proportion of live weight tended to decrease slightly as rate of gain increased.

(Key Words: Feedlot, Carcass Measures, Growth Rate.)

### Introduction

"Any steers gaining over 2 pounds per day are depositing fat, not lean!" This is a commonly accepted concept. It was extrapolated from a number of experiments in which groups of cattle have gained weight at different rates, either due to limit feeding or to differences in diet composition (Byers and Rompala, 1979). In such experiments, cattle usually are slaughtered at similar weights so they differ in age and in time-on-feed. Swine experiments indicate that older animals are leaner; backgrounding experience also supports the idea that frame size is dependent on animal age. Hence, age can bias this relationship so that cattle gaining faster are younger at slaughter and thereby fatter. Some evidence indicates that diet and end-products of fermentation can influence carcass composition independent of rate of gain.

If faster gaining cattle are fatter, this should reduce their cutability and value per pound providing they have adequate marbling to grade. Though comforting to producers with slow gaining animals, selecting or feeding for slow rates of gain to improve carcass merit seems backward. If fast rates of gain are primarily due to increased fat deposition, then selecting sires on the basis of gain during performance tests would mean that cattle are being selected partially for increased fat deposition at the expense of protein! Selection could simultaneously increase protein deposition, though curves relating empty body weight gain which have been widely circulated indicate that rate of protein gain plateaus when rate of empty body weight gain approaches 2 lb per day while rate of fat deposition skyrockets at this point. The objective of our research was to determine the relationship of carcass measurements of steers to rate of live weight gain of individual steers within a series of feeding trials.

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## Materials and Methods

Information on individual animal performance on 2771 steers fed in 15 different feedlot trials over the past 12 years was compiled. Cattle were predominantly medium framed yearlings, crosses of a wide variety of breeds typical of feedlot cattle in the Southern Great Plains, and were implanted and fed in tests of a wide variety of feed additives. Indicators of deposition of lean (ribeye area, cutability, weight of lean cuts) and of fat deposition (fat thickness over the rib, kidney-pelvic-heart percentage, dressing percentage and marbling) were regressed first against rate of live weight gain of steers across all trials and, in a second comparison, within each of the 110 to 160 day trials. Calculating regressions within trials would help to remove some environmental and genetic components which could be involved in these relationships. To check for curvilinearity, regressions were calculated against rate of live weight gain and rate of live weight gain squared. When the quadratic function was significant ( $P < .05$ ) it was retained; if not, it was removed from the model. Of primary interest was total weight of lean cuts, calculated as cutability times hot carcass weight. Plots of relationships were prepared to illustrate these relationships.

## Results and Discussion

Relationships between rate of weight gain and carcass measurements across all steers are presented in table 1. For clarity, these equations were used to calculate expected means for cattle gaining live weight at rates of 1 to 4.5 lb per day as presented in table 2. In addition, plots of specific relationships showing the distribution of values for individual animals are presented in figures 1 through 5. First, ribeye area increased linearly ( $P < .05$ ) with rate of weight gain indicating that more lean tissue was being deposited by steers gaining at faster rates. The curvilinearity of ribeye area was not significant (quadratic term,  $P = .11$ ; table 1). Despite a wide range in values for individual steers (figure 1), the trend is certainly upward. Yield grade, fat thickness over the rib, kidney-pelvic-heart fat percent, marbling score, hot carcass weight and dressing percentage also

Table 1. Statistical relationships of carcass traits to rate of gain.

	Ribeye area in <sup>2</sup>	Yield grade	Cuta- bility %	Rib fat in	KPH %	Marb- ling score	Hot weight lb	Lean cuts lb	Dress- ing %	Lean cuts % WT
Intercept	11.01	.877	54.87	.115	.648	9.89	440	250.3	60.27	33.2
Linear effect										
ADG	.432	.917	-2.16	.153	1.105	2.26	87.28	30.14	1.66	-.53
Prob. <sup>a</sup>	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.002	.0001
Quadratic effect										
ADG	NS	-.107	.250	-.018	-.166	-.359	-3.14	NS	-.317	NS
Prob.	.111	.0001	.0001	.0001	.02	.0001	.04	.77	.0001	.89
Mean value	12.42	2.68	50.56	.421	2.41	13.28	691	349.2	62.17	31.4
R <sup>2</sup>	.05	.05	.05	.02	.03	.01	.42	.37	.02	.06

NS Not significant and deleted from the model.

<sup>a</sup>Probability of significance of above effect.

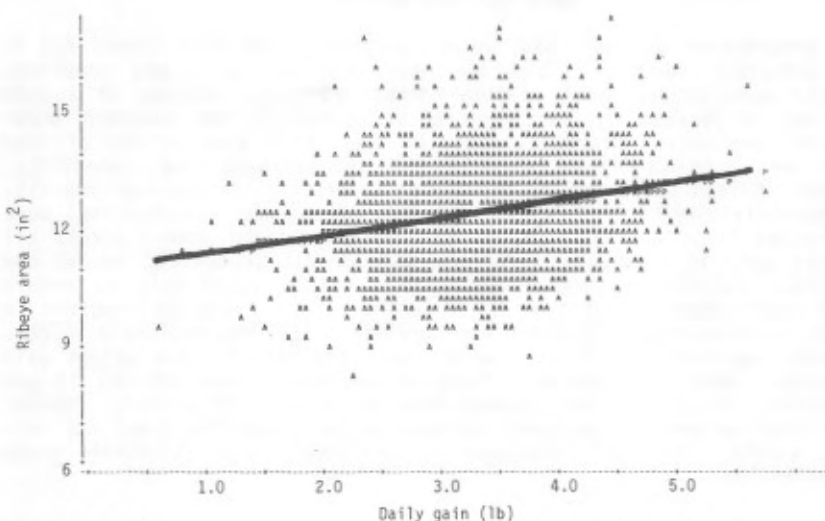


Figure 1. Plot of ribeye area (square inches) against rate of live weight gain for finishing steers. Statistics are in table 1.

increased, but at decreasing rates as rate of gain increased. Because fat thickness increased, cutability, an index of the percentage of carcass weight in closely trimmed lean cuts, was lower for steers gaining at more rapid rates. Fat thickness tended to plateau at a daily gain of about 3 pounds per day (figure 2) in marked contrast to previous suggestions that total fat deposition should increase greatly at rates of gain above 2 pounds per day. Note that marbling score plateaued for steers at 3 pound daily gains and was lower with faster rates of gains (table 2). This may indicate that steers making extremely rapid gains were of a type that had very large mature size and limited marbling.

Because carcass weights were greater for cattle gaining at faster rates while cutability decreased (figure 3), the weight of lean cuts, which should serve as an index of quantity of lean cuts produced by cattle gaining at the various rates of gain, increased (table 2). Despite this increase in weight of lean cuts, expressed as a percentage of final live weight, lean cuts as a percentage of live weight decreased as rate of live weight gain increased (figure 4). Changes, however, were quite small. Based on this regression (table 2), steers gaining at a rate of 1 lb daily were depositing .330 lb of closely trimmed lean cuts, whereas steers gaining at the rate of 4.5 lb daily were depositing .308 lb of lean for every lb weight gain, a decrease of only 6.7% despite the 3.5 pound increase in daily gain.

Surprisingly, dressing percentage was lower with more rapid rates of gain (figure 5) and heavier carcasses. Dressing percentage reflects two factors - it increases as more fat is deposited but it decreases as proportional size of the gut and viscera increase. One would expect from the hot weights and fat thickness over the rib that faster gaining

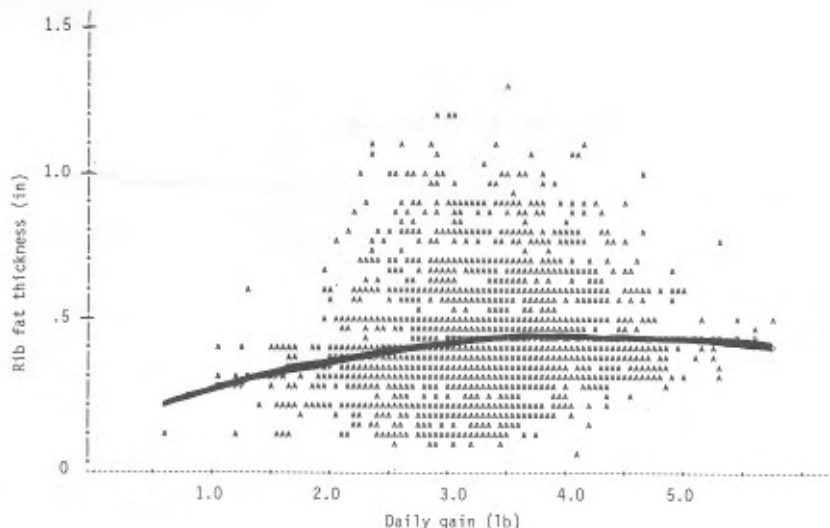


Figure 2. Numerical relationship of carcass traits to rate of gain by steers.

Table 2. Numerical relationship of carcass traits to rate of gain by steers.

Rate of gain lb/day	Rib eye area in <sup>c</sup>	Yield grade	Cuta- bility %	Rib fat in	KPH %	Marb- ling score	Hot weight lb	Lean cuts lb	Dress ing %	Lean cuts % WT
1.00	11.44	1.69	52.96	0.25	1.59	11.79 <sup>a</sup>	524	280	61.61	33.0
1.50	11.66	2.01	52.19	0.31	1.93	12.47	564	296	62.05	32.5
2.00	11.87	2.28	51.55	0.35	2.19	12.97	602	311	62.32	32.2
2.50	12.09	2.50	51.03	0.39	2.37	13.30	639	326	62.44	31.8
3.00	12.31	2.67	50.64	0.42	2.47	13.44	674	341	62.40	31.6
3.50	12.52	2.78	50.37	0.44	2.48	13.40	707	356	62.20	31.3
4.00	12.74	2.83	50.23	0.45	2.41	13.19	739	371	61.84	31.0
4.50	12.95	2.84	50.21	0.45	2.26	12.79	769	386	61.32	30.8

<sup>a</sup> Slight plus=12; Small minus=13.

cattle should be fatter and thereby that dressing percentage should be higher with higher rates of gain. Such an increase in dressing percentage was not apparent. The other factor, viscera weight, would be expected to be greater for cattle gaining more rapidly because size of the gut and liver must expand to handle larger amounts of nutrients. A change in gut size and weight could explain the lower dressing percentages for faster gaining cattle.

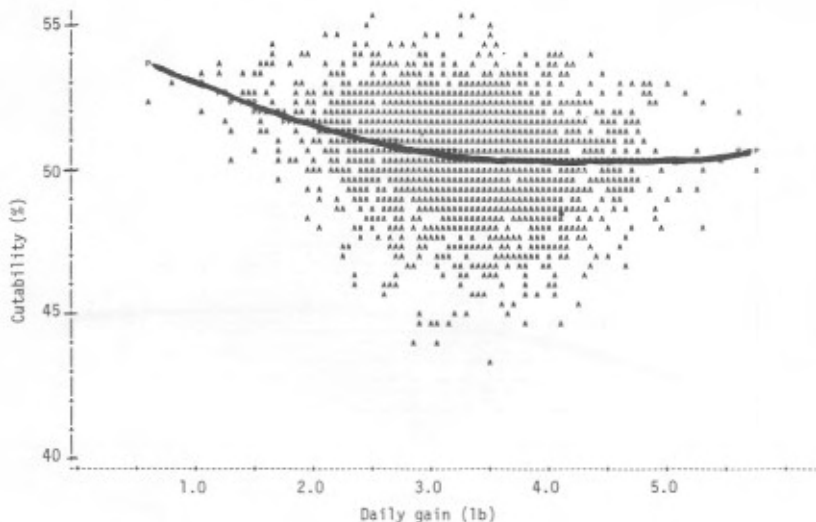


Figure 3. Plot of cutability (closely trimmed retail cuts as a percentage of carcass weight) against rate of live weight gain for finishing steers. Statistics are in table 1.

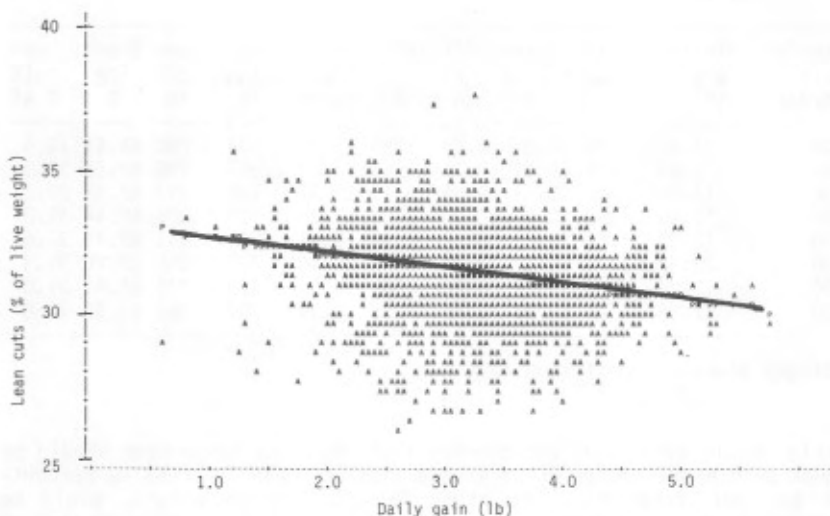


Figure 4. Plot of closely trimmed retail cuts as a percentage of live weight against rate of live weight gain for finishing steers. Statistics are in table 1.

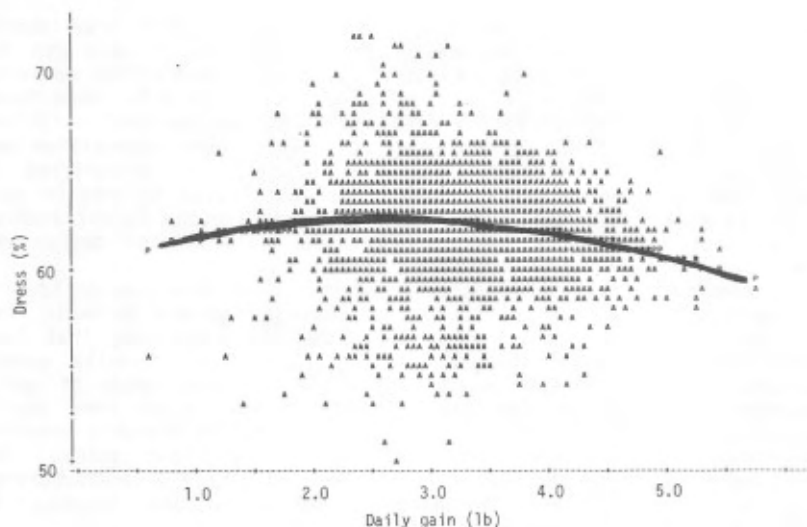


Figure 5. Plot of dressing percentage (hot carcass weight/live weight) against rate of live weight gain for finishing steers. Statistics are in table 1.

To determine whether certain environmental or genetic factors might be biasing the relationship of carcass traits to rate of gain, regressions were calculated including trial in the model. Results are presented in table 3. Including trial in the model had little impact on the relationships though mean values changed slightly.

In summary, curves relating carcass measurements to rate of gain indicate that deposition of lean did not plateau for cattle gaining up to 4.5 lb/d. Fat deposition, however, did increase at a decreasing rate as rate of gain increased, so cutability decreased. Although the incremental change in lean deposition was lower with more rapid rates of gain, no plateau in lean deposition was reached over the range of

Table 3. Relationship of carcass traits to rate of gain by steers with effect of trial removed.

Rate of gain lb/day	Rib eye area in <sup>c</sup>	Yield grade	Cutability %	Rib fat in	KPH %	Marbling score	Hot weight lb	Lean cuts lb	Dressing %	Lean cuts % WT
1.00	11.98	2.0	52.2	0.25	2.0	11.8 <sup>a</sup>	505	264	62.8	32.8
1.50	12.01	2.2	51.6	0.31	2.2	12.3	558	288	62.7	32.4
2.00	12.03	2.5	51.1	0.35	2.3	12.8	606	310	62.6	32.0
2.50	12.06	2.6	50.7	0.39	2.4	13.1	650	330	62.4	31.6
3.00	12.09	2.8	50.3	0.42	2.4	13.3	691	348	62.2	31.3
3.50	12.11	2.9	50.0	0.44	2.4	13.4	728	364	61.9	30.9
4.00	12.14	3.0	49.8	0.45	2.5	13.4	760	379	61.5	30.6
4.50	12.16	3.0	49.7	0.45	2.5	13.2	788	392	61.0	30.3

<sup>a</sup> Slight plus=12; Small minus=13.

gains achieved. Results are from cattle provided with free choice access to feed. Restricting energy intake and rate of gain can influence composition of gain. Plateaus in protein deposition would be expected to occur at faster rates of gain for cattle with large frame sizes and with growth-promoting feed additives and implants. Failure to detect major effects of rate of gain on carcass composition and cutability in our study indicates that some of the differences in protein and fat deposition which have been attributed to rate of gain in the past probably should have been ascribed instead to differences in age, nutrient availability and balance, experimental design and animal type and sex.

In conclusion, cattle producers concerned that selection or feeding for rapid rates of gain will greatly increase fat and decrease lean deposition can draw comfort from these results suggesting that lean deposition continues to increase to at least 4.5 lb daily gains. Although carcass leanness can be enhanced by slower rates of gain, slaughtering faster gaining cattle with fewer days on feed should accomplish the same objective without sacrificing the economic benefits and reductions in fixed costs attained through fast gains. The decreased dressing percentage of faster gaining cattle deserves further study as it may reflect increased viscera weight and, thereby, an increased energy requirement for maintenance.

#### Literature Cited

- Byers, F. M. and R. E. Rompala. 1979. Rate of protein deposition in beef cattle as a function of mature size and weight and rate of empty body growth. Ohio Agr. Res. Devel. Center Beef Cattle Research Report Anim. Sci. Series 79-1. p. 48.