Efficiency of Gains by Beef Calves as Influenced by Weight and Rate of Gain

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The feeding of beef cattle for slaughter is a major enterprise in the American beef industry. Some factors which affect the efficiency of feed utilization by cattle during growth and fattening have been identified and appraised; other factors have received little attention.

The recent abundance of feed grains at relatively low costs and the increased demand for quality beef from younger cattle of lighter weights have caused some rather marked changes affecting both producers of feeder calves and feeders. To produce a 900 to 1000 pound steer of choice grade at 12 to 16 months of age requires the full feeding of such cattle from the time they are weaned.

In recent years the price of choice feeder calves at weaning time has been from four to six cents per pound higher than the price of fat cattle of the same quality. With pressure by the retail chain stores for carcasses weighing from 500 to 700 pounds, feeders have been looking for calves of lighter weights. This pressure has sometimes been so great that calves weighing 400 pounds have brought almost as much per head as those of similar quality weighing 500 pounds. Feeder calf producers know that it costs just about as much to produce a 400 pound calf as to produce one weighing 500 pounds. They have been striving to produce this heavier calf through selection of better breeding stock and through better management. These conflicts of interest have been brought into rather sharp focus during recent years.

Experimental Procedure

During the past five years at the Ft. Reno station, some 285 steer calves and 44 heifer calves of Angus breeding have been full fed from weaning at approximately seven months of age to a slaughter age of about 13 months. These calves have provided data on some factors which have a bearing on the efficiency of feed lot gain.

The Angus calves were produced in a herd belonging to the Federal Reformatory at El Reno. During the breeding season 250 mature cows were randomly allotted to 10 breeding groups of 25 cows each. Ten selected Angus bulls were randomly assigned, one to each breeding group, and the breeding season lasted for about three months beginning in early May each year. The calves were weighed, tagged, and tattooed at birth. All bull calves were castrated. All calves were creep-fed, and they were weighed and graded at weaning time in early October. In 1957 and 1958 seven sire progeny groups were purchased for post-weaning feed lot tests and carcass appraisals. Calves of both sexes were fed

for three sires in 1957 and for six sires in 1958. They were self-fed, by sexes in sire progeny groups of four to six head, a complete mixed ration. Feed consumption records and weight gains were kept so that feed efficiency for each pen could be computed.

During 1959, 1960, and 1961 only steer calves were purchased for the post-weaning tests. Sixty calves by 10 different sires were obtained each year. They were the calves nearest the average birth date. Each sire group was divided into a heavy and a light weight group for the feed lot test. The heavy half of the calves by each sire was fed as a group in one pen, while the light weight half of the calves by each sire was fed as a group in an adjoining pen. All calves were self-fed the same complete mixed ration. Feed consumption records and weight gains were kept for each pen. Feed efficiency data were obtained for both groups of calves which were sired by the same bulls. They differed slightly in ages but rather markedly in weights at weaning.

Beginning and final weights were obtained following a shrink of some 18 hours off water and some six hours off feed. Average daily gains, feed efficiency, and dressing percentages were based upon these shrunk live weights and the chilled carcass weights in the latter case. The calves were weighed each 14 days and feed consumption records were kept separately for each period.

The ration fed was made up of the following ingredients:

35 percent ground whole ear corn
20 percent cottonseed hulls
10 percent ground alfalfa hay
10 percent whole oats
10 percent wheat bran
10 percent cottonseed oil meal
5 percent molasses

This mixture contained approximately 9 percent digestible protein and 63 percent total digestible nutrients. A mineral mixture of equal parts of salt and calcium carbonate was fed in a separate container. Water was available in each pen; sufficient shed space was available; and sand was used as the bedding material. No growth stimulants or antibiotics were implanted or fed.

At the completion of the feed lot tests the cattle were slaughtered in Oklahoma City where carcass weights were obtained following a 48 to 72 hour chill. Each carcass was graded by Federal graders to the nearest third of a grade.

Results and Discussion

To determine the amount of feed required per 100 lbs. of gain by these calves during different periods of growth and fattening, the data

Table 1.—Amount of Feed Required Per 100 Lbs. of Gain for Steer Calves During Different Periods of Growth.

Approx. Wt. Gps.	No. Yrs.	No. Calves	Lbs. Feed per 100 Lbs. Gain
425 - 500	3	107	419
501 - 600	5	253	682
601 - 700	5	271	916
701 - 800	5	284	1038
801 - 900	5	233	1235

for all steers were examined. Table 1 presents the results of this study. The increased feed requirement per unit of gain with increasing body weights was quite marked and this was expected. Undoubtedly the estimate for the first weight group (425 to 500 lbs.) is too low; and for the last weight group (800 to 900 lbs.) it may be too high, as the initial and final weights were obtained following the rather severe shrink described earlier. The intervening 14-day weights were obtained after a 12 hour period off water, but feed was not withdrawn for these weights. Differences in fill would have made the initial period appear to have been more efficient and the final period appear to have been less efficient than they should have been. The average steer weighed about 475 lbs. at the beginning of the test and about 900 lbs. at the end of the feeding period. The data shown for the weight groups from 500 to 800 lbs. were based upon more animals and would not be biased to the same extent by differences in fill. It is obvious that as calves became heavier and fatter, it takes more feed for each unit of additional gain.

The differences in feed requirement for calves of different weights during a feeding test of six months are shown in Table 2. The 104 calves in the heavy groups were sired by the same bulls as the 107 calves in the light weight groups. The heavy calves were heavier than their light weight half brothers by 71 lbs. at the beginning of the test, and they were 12 days older at that time. For the three year period the two groups gained at about the same rate. The two groups did not differ appreciably in dressing percentage or in carcass grades, indicating that the composition of gain for the two groups was similar. The heavier groups required 980 lbs. of feed per 100 lbs. of gain to reach a final slaughter weight of 942 lbs., while the lighter groups required 934 lbs. of the same ration per 100 lbs. of gain to reach a final weight of 866 lbs. The heavier calves required 46 lbs. more feed per 100 lbs. of gain to maintain the additional 71 to 76 lbs. of body weight during the period of this test. At a feed cost of two cents per pound this would have meant a difference in the feed cost per 100 lbs. of gain of about 92 cents. In this case, where the heavier calves gained 427 lbs., the added feed cost for the heavier calves was about four dollars per head above that of their half brothers which weighed 71 lbs. less at the start of the test.

Table 2.—Performance of Steer Calves Fed in Groups Which Differ in Initial Weight.

Year	Grp.	No. Steers	Initial Age	Initial Wt.	Final Age	Final Wt.	ADG	Dr. %	Carc Gr.[1]	Lbs. Feed 100 lbs.Gain
1959	H	28	217	520	388	942	2.47	63.1	10.7	991
	L	31	200	434	371	843	2.39	61.4	11.2	946
1960	H	39	214	497	413	953	2.29	63.7	10.4	988
	L	39	209	431	408	889	2.30	63.2	10.6	924
1961	H	37	225	528	393	931	2.40	62.5	11.1	960
	L	37	213	467	381	867	2.38	62.6	10.9	933
Avg.	H	104	219	515	398	942	2.39	63.1	10.7	980
	L	107	207	444	386	866	2.36	62.4	10.9	934
Diff. H-L		=	12	71	12	76	.03	0.7	—0.2	46

[1]Carcass Grades: Low Choice, 10; Avg. Choice, 11; High Choice, 12.

Differences in feed efficiency found here would have justified a price spread of a little less than one cent per pound for feeder calves of these weights when they were of comparable breeding and quality.

It was interesting that the calves which were heavier at weaning gained as fast as did their lighter weight half-sibs. No evidence of compensatory gain by the smaller calves was noted in this three year test. The similarity of the two groups in dressing percentage and carcass grades was also very interesting in view of the youth of the cattle at slaughter. Perhaps the fact that all calves had been creep-fed prior to weaning is significant in this connection.

Breeders and producers of feeder calves have claimed that calves having the genetic capacity for more rapid gains, which may be expressed in heavier weaning weights, also make more rapid and efficient gains in the post weaning period. Numerous studies have shown that rapid feed lot gains are the more efficient gains. Through weight constant tests this association has been found to be very high. At the same time the genetic correlation between rate of gain in the preweaning and post-weaning periods has been quite high if the calves have been exposed to nutrient levels conducive to rapid gains in both periods. For the feeder to get and feed fast gaining, efficient calves he will usually have to buy calves which are heavier at a given age. If he requires them to be light in weight, he would have to buy them at younger ages.

There are some contradictory relationships among rate of gain, feed efficiency, and weight. Fast gains are associated with efficient feed conversion, but fast gains automatically lead to heavier weights which reduce feed efficiency. The data obtained in 1957 and 1958, when the

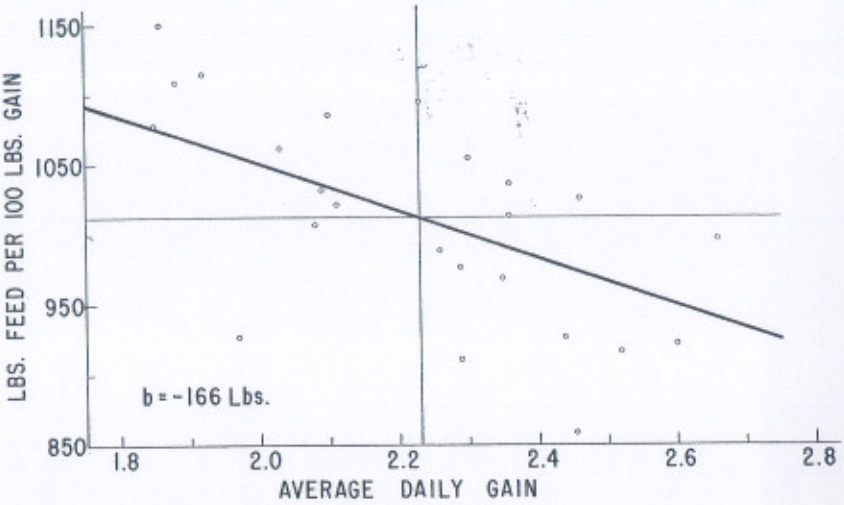

Figure 1. Intra-Season, Intra-Sex Regression of Pounds Feed Per 100 Lbs. Gain on Average Daily Gain of Sire Groups.

sire progeny groups were fed in separate pens, show that the calves which are the fast gaining progeny were more efficient in feed use, in spite of their heavier weights at the beginning and at the end of the tests. This information is given in Table 3 and in Figure 1. The intra-season, intra-sex regression coefficient was —166 lbs. This means that for an increased rate of gain of .1 of a pound per day, the feed required per 100 lbs. of gain was reduced nearly 17 lbs., in spite of the fact the faster gaining calves were heavier.

The data presented in Table 3 for the different pens and sires reveal one of the reasons why rate and efficiency of gain were not more closely related. In 1957 two pens of calves by sire 264 were fed. They differed by nearly 100 lbs. in body weight during the test. The 638 lb. calves gained 2.66 lbs. per day for the entire test while their 546 lb. half-sibs gained 2.60 lbs. per day on the same test. The heavier calves in this sire group required about 75 lbs. more feed per 100 lbs. of gain than was required for their 546 lb. half brothers. In the same year, however, the calves by sire 15, which weighed 515 lbs. and gained only 2.03 lbs. per day, required 1062 lbs. of feed per 100 lbs. of gain. This was 100 lbs. more than that required by the 10 much heavier calves by bull 264. If one were to assume a selling price of 25 cents per pound for the slaughter steers, and a feed cost of 2 cents per pound, he could show that 546 lb. feeder calves could be worth, to the feeder, about 1½ cents per pound more than the 638 lb. group by the same sire. They

Table 3.—Performance of Steers and Heifers Fed by Sire Progeny Groups.

Year	Sex	Sire	No. Calves	Initial		Final		ADG	Lbs. Feed 100 Lbs. Gain
				Age	Wt.	Age	Wt.		
1957	M	264	5	230	638	389	1051	2.66	998
	M	264	5	224	546	383	949	2.60	923
	M	114	3	242	607	401	985	2.44	926
	M	114	4	235	541	394	905	2.35	969
	M	2	6	231	532	390	898	2.36	1014
	M	5	4	214	528	373	926	2.57	917
	M	17	6	197	517	356	898	2.46	1026
	M	15	6	234	515	393	830	2.03	1062
	M	7	6	193	472	352	854	2.46	859
1958	M	115	5	224	561	392	948	2.08	1007
	M	155	5	236	539	404	890	2.09	1032
	M	7	5	224	510	392	890	2.26	989
	M	6	5	231	505	399	891	2.30	1054
	M	175	5	219	482	387	836	2.11	1022
	M	185	4	195	454	363	838	2.29	912
1957	F	264	4	230	564	389	930	2.36	1037
	F	114	5	239	498	398	823	2.10	1086
	F	5	6	210	448	369	803	2.29	977
1958	F	115	5	226	533	394	846	1.86	1150
	F	185	4	233	508	401	839	1.97	927
	F	175	5	229	489	397	804	1.88	1108
	F	155	5	213	472	381	794	1.92	1114
	F	5	5	199	450	367	760	1.85	1078
	F	6	5	215	450	383	824	2.23	1095

would have been worth 2½ cents per pound more than the 515 lb. calves by sire 15. This points out the need for information on reasons for weight differences among calves. If calves are heavy because they are older or have been on a higher plane of nutrition, they may be less efficient in their gains. If they are heavy because they have greater genetic capacity for growth, they may be more efficient in their gains in spite of their heavier weights. This means that the producer of feeder calves needs to know the genetic capacity of his cattle and that feeders need to purchase cattle with the greater probability for efficient gains. Initial weight alone is not a good indication of the future performance of calves.

In Table 4 is given the average growth data for each of the 30 sire groups of steers fed during 1959, 1960, and 1961. The tremendous differences which occur between sire progeny groups in growth rate emphasize the opportunity which exists for the improvement of this trait in beef cattle by selection. Average differences of from .4 to .6 of a pound per day were found each year. In cases where some sires were repeated in different years, there was remarkable consistancy in progeny

performance from year to year. Sires 264 and 6 sired calves which gained about .4 of a pound per day more than those of sire 21 in 1959. Those sired by the same two sires gained nearly .6 of a pound per day more than those by bull 21 in 1960.

Calves by sire 21 in 1961 weighed 838 lbs. at slaughter age of 395 days, while those by sire 158 weighed 988 lbs. at 389 days of age. The dressing percentage and carcass grades for these two sire groups did not differ. Under these circumstances one can see that the calves by 158 would be much more profitable than those by sire 21 to both the producer of feeder calves and the feeder, even if they changed hands at the same price per pound. They were actually worth about 2 cents per

Table 4.—Performance of Steers by Thirty Sires Fed in Groups During 1959, 1960, and 1961.

Year	Sire	No. Calves	Initial Age	Initial Wt.	Final Age	Final Wt.	ADG	Dr. %	Carc. Gr.[1]
1959	264	7	199	483	370	949	2.62	62.4	11.1
	21	7	211	451	382	848	2.23	63.3	11.9
	6	5	219	501	390	963	2.60	61.7	10.4
	426	8	202	474	373	941	2.62	62.3	10.6
	436	6	202	499	373	950	2.53	61.7	10.2
	096	6	211	478	382	928	2.53	61.7	10.8
	196	7	204	493	375	941	2.52	63.9	10.4
	066	3	212	437	383	865	2.40	62.0	12.3
	406	4	220	459	391	859	2.25	61.9	11.0
	046	6	212	454	383	854	2.25	61.1	11.8
1960	264	5	207	487	406	986	2.51	64.0	11.0
	21	4	214	455	413	839	1.93	64.2	10.8
	6	5	215	503	414	995	2.52	62.8	9.0
	157	7	204	470	403	980	2.56	63.3	10.7
	047	6	207	437	406	936	2.51	63.2	10.3
	22	4	217	445	416	919	2.38	63.7	11.0
	327	8	213	496	412	967	2.37	64.2	10.9
	187	8	210	443	409	894	2.27	63.3	10.2
	337	8	212	446	411	891	2.24	63.7	10.8
	24	5	210	448	409	890	2.22	64.2	10.4
1961	158	6	221	543	389	988	2.65	63.3	11.0
	328	6	228	522	396	931	2.43	62.5	11.3
	23	6	222	522	390	930	2.43	63.0	11.7
	258	6	222	517	390	898	2.27	63.3	10.8
	24	6	220	516	388	924	2.43	63.0	10.8
	468	6	218	510	386	917	2.42	61.6	11.8
	048	6	212	496	380	904	2.43	62.7	11.5
	038	6	214	475	382	882	2.42	61.5	10.3
	21	6	227	468	395	838	2.20	62.6	11.5
	22	6	214	457	382	817	2.14	63.5	11.2

[1]Carcass Grades: High Good, 9; Low Choice, 10; Avg. Choice, 11; High Choice, 12.

pound more because they were more efficient in their gains. In recent years the prices paid per pound would likely have been the reverse of the above values because the genetic superiority or inferiority of sires was unknown to producers and feeders. The feeder who paid a premium price for the calves by sire 21 would have been at an economic disadvantage, while the producer of the calves by sire 158 would not be getting proper remuneration for his calves. However, the 543 lb. calves by 158 would bring the producer as many dollars at 28 cents per pound as would the 457 lb. calves by sire 21 at 33 cents per pound.

If strong pressure against heavy calves is encountered by a producer who has unusually rapid gaining calves, he could sell at younger ages to take advantage of the higher prices being offered for the lighter weight calves or he might wish to feed them for slaughter, himself. Because feeder demand for calves of different weights changes, varying with the price of feed and the price of fat cattle in relation to the price of feeder calves, the breeder and producer of feeder calves will do well to keep a long range objective in mind. Changes in genetic capacity are made only by considerable selection over a period of years. He can better meet temporary shifts in demand by altering management practices than by changing goals in selection. If heavy calves are in demand, he can creep-feed his calves and wean them at an older age. If light weight calves are more profitable to him, he can wean them at a younger age without creep. The breeder who produces cattle with superior genetic capacity for gains and grades is better able to make adjustments to changing demands. The breeder who knows the genetic capacity of his cattle is also better able to negotiate intelligently with his customer in arriving at a price which is fair to both.

Methods of Processing Milo for Fattening Steer Calves

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Grain sorghum is the chief concentrate for fattening cattle in most areas of the Southwest. During the past few years, several changes of importance relative to this feed grain have taken place. For one thing, new varieties of hybrid grain sorghum, heavy fertilization, and irrigation have greatly increased the yields per acre, and also may have affected the chemical composition of the grain, especially its protein content. Another change has taken place in the feeding of the grain. No longer is most of our grain processed on the farm. Today, new methods of processing (dry or steam rolling, pelleting, etc.) are available to either the large feeder or the small operator who buys a complete fattening ration from a well-equipped feed mill.