A COMPARISON OF GROWTH AND FEED EFFICIENCY IN STEERS AND BULLS ON AN ALL CONCENTRATE RATION

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FATTENING STEERS AND BULLS

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AN ABSTRACT OF THE THESIS OF

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Title: A comparison of growth and feed efficiency in steers and bulls on an all-concentrate ration.

An all-concentrate ration containing 45% dry molasses beet pulp was fed from April 5, 1965 till April 4, 1966 to steers and bulls in a comparative feeding trial. The effect of 2 levels of vitamin A injected intramuscularly at monthly intervals to each group was also studied. Bulls had higher average daily gain and better feed efficiency than steers. Animals receiving monthly intramuscular injections of 250,000 I.U. of vitamin A had gains equal to those receiving 500,000 I.U. Serum and liver vitamin A values at time of slaughter were higher in animals receiving the higher dose. Mean liver vitamin A values for calves receiving the lower level were quite low but within the normal range. Carcass measurements showed slightly bigger rounds, better carcasses and higher fat percentage for steers, however bulls had higher lean meat percentage.

An analysis of cost and net return showed bulls to be more profitable than steers.

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I. INTRODUCTION

The production of beef in many of the Middle Eastern countries lags behind the demand. In Lebanon 60 percent of the consumption is imported. The potential for an increase in local production is limited by shortage of suitable animals and also roughages. If bull calves from dairy herds could be fattened for beef at a cost competitive with imported beef, the home production could be increased considerably.

If the use of roughages in fattening animals could be dispensed with and relatively cheap concentrates used as the main part of the ration. the cost of producing beef could be lowered considerably.

One locally produced feed which is relatively cheap is dry molasses beet pulp. In 1961 sugar beet production was estimated at 24,000 tons (Worzella et al., 1962). Samman (1964) estimated the production at 32,000 tons from which approximately 2,500 tons of dried molasses beet pulp are produced. According to Agricultural Statistics Division, Ministry of Agriculture (1964), the sugar beet production increased to 77,000 in 1964 which corresponds to 6,016 tons dried molasses beet pulp.

Another relatively inexpensive and locally available feed is wheat bran, a by-product of the milling industry.

This study was designed to investigate the use of large amounts of dried beet pulp and wheat bran in an all-concentrate ration on the performance of steers and bulls. Since the ration was extremely low in carotene, the effect of 2 levels of vitamin A injected intramuscularly at monthly intervals was also studied.

II. REVIEW OF LITERATURE

Several experiments have been reported in the literature on fattening beef cattle on an all-concentrate ration. Some researchers have used barley as the main ingredient of the ration while others have used other cereal grains. Dry molasses beet pulp has not been as widely used as other feedstuffs.

Sadovnikova (1959) has reported on the feeding value of beet pulp with urea. In a trial lasting 73 days 4 groups of 19 Simmental cross-bred cattle, initial average weight 226 kg, were fed daily 40 to 43 kg of beet pulp silage in addition to a concentrate mixture. The first group received no urea while the other groups were given daily 45, 75 and 118 gm, respectively. The rations containing urea were consumed readily and no ill effects were observed. Groups receiving 0, 45, 75 and 118 gm of urea had daily gains of 1000, 1123, 1110 and 932 gm and feed efficiencies of 6.7, 5.7, 5.8 and 6.6 feed units per kg gain, respectively. Dressing percentage was higher in all groups which received urea than in the control group while body fat was lowest in the group which received highest level of urea. There was no significant difference in quality of meat or fat among the groups.

Lowest intake of concentrates and lowest feed costs were obtained for the groups receiving 45 and 75 gm of urea daily. Manuelian (1965) compared weight gains and feed efficiency in bulls fed dry beet pulp and beet pulp silage. One group was fed 55% concentrate and 45% dry beet pulp. A corresponding amount of dry matter in beet pulp silage was consumed by the other group. Both groups had satisfactory gains but the dry beet pulp group had a non-significant higher daily gain than the group fed silage. Feed efficiency was slightly better in the silage group.

Kercher and Bishop (1963) studied the influence of an all-concentrate ration on the growth and carcass characteristics of beef cattle. Fifty-one yearling Hereford steers were fed steam-rolled barley, steam-rolled oats, steam-rolled milo or beet pulp pellets as single grains in addition to a supplement of dehydrated alfalfa pellets (12.5% of the ration). Daily gains and feed consumption were measured. A few cases of bloat and founder occurred, but there were no death losses. Average daily gains in pounds and pounds of feed per pound of gain were 2.9, 7.15; 3.0, 7.80; 3.1, 7.47; and 2.0, 9.91 for steers fed barley, oats, milo or beet pulp, respectively. The carcass yield (%) and carcass grade (9 = average choice) were 60.9, 8.9; 57.4, 7.9; 62.6, 9.2; 60.8, 6.8 for barley, oats, milo and beet pulp fed steers, respectively. These differences were not statistically significant.

The beet pulp fed steers had significantly lower levels of propionic acid and significantly higher levels of acetic acid in the rumen than steers fed the other rations. Butyric acid levels were highest in steers fed barley, followed by those fed oats, milo and beet pulp.

Charton (1954) has reported disturbances of the digestive system in cattle such as diarrhea and bloat when fed beet pulp.

Preston (1963) fed beef animals a ration consisting of 85% rolled barley and 15% of a supplement containing 30% protein. Very satisfactory gains were obtained; however, bloat, acidosis, kidney necrosis, and liver abscesses were observed in some animals.

Ivanov and Zahariev (1962) reported trials comparing the performance of bulls and bullocks (steers). Fifteen bulls and 15 bullocks castrated at about 10 months of age were fattened for 240 days. Initial weight was 291 kg and approximate age 285 days. The average daily gain of bulls was 1058 gm and for bullocks 952 gm. Bulls required 6.46 feed units per kilogram gain and bullocks 7.20. Bullocks laid down more abdominal fat than bulls.

Richter _et al_. (1961) have studied the effect of late castration on fattening performance, carcass value and carcass quality. Nine bullocks were castrated at an average age of 360 days. Thirteen days after castration the bullocks and a similar group of bulls weighing 301 and 319 kg respectively, were housed individually and fed corn silage and brewer's grain. The duration of the feeding period was 191 and 204 days, and final average live weights were 479 and 563 kg, respectively. Mean intakes per day were: Digestible protein 900 and 930 gm, starch units 4.695 and 5.060 for bullocks and bulls, respectively. The bulls converted the feed into live weight more efficiently than the bullocks. Dressing percentage was 0.8 percentage unit higher for bulls than for bullocks and bullocks were judged to have the poorer carcasses.

Prescott and Lamming (1964) compared the daily gains, dressing percent and meat quality of bulls and bullocks. In an experiment with 9 male Friesian and 2 Hereford x Friesian, 5 were castrated at 7 months of age. Both bulls and steers were fattened to 13 months of age. With advancing age the relative amount of a compound feed was decreased and barley and beet pulp increased. Hay was fed *ad libitum*. Average daily gain of bulls was 2.28 lb as compared with 2 lb for bullocks. The concentrate consumption was equal, but the bulls ate ½ a pound more hay per day than the bullocks. Bulls had more gut-fill than bullocks, but the dressing percentage was similar. The bulls had heavier forequarters, less external marbling and internal fat in the carcass than the bullocks. A taste panel found the meat from the bulls satisfactory. Vezzani *et al.* (1954) and Homb (1958) have also reported that bulls gain faster than steers.

The effect of supplementing vitamin A to the rations of beef animals has been studied by several workers. Hale *et al.* (1962) studied various levels of vitamin A on the performance of beef animals. Six pairs of Hereford steers averaging 731 lb live weight were fattened for 168 days on a ration composed of rolled milo grain, cottonseed hulls and cottonseed meal fortified with dicalcium phosphate and salt; block salt was always available. To the rations were added 0, 10,000, 40,000, 160,000, 640,000 or 2,560,000 I.U. vitamin A daily as stabilized vitamin A palmitate mixed with the concentrate. Liver samples were obtained by biopsy at the beginning, on 5 occasions during the progress of the experiment and after slaughter. Blood samples were analysed for vitamin A more frequently. At the outset vitamin A in liver ranged from 90 to 130 with a mean of 112 ug per gm wet tissue. By the end of the experiment, liver storage in animals not given vitamin A was almost depleted and in those given 10,000 I.U. daily, it had fallen to ½; 40,000 I.U. daily sufficed to maintain initial values. Little vitamin A was stored in other tissues, except the fat of those given the greatest amount of the vitamin. Values in plasma were related to amount fed rather than to values obtained in liver. Vitamin A in feces increased only when the 2 greatest amounts were given. Total serum protein, albumin and globulin were unaffected by vitamin A level in the feed. There was no significant difference in rate of gain, feed efficiency, dressing percentage or grade of carcass. The steers given the 3 highest levels of vitamin A ate more salt than the others. Ross and Knodt (1948) studied the effect of vitamin A supplementation. Twenty-eight Holstein heifers were used and divided into 2 groups as similar as possible in age, body weight and content of carotene and vitamin A in the blood plasma. The basal ration of all the calves supplied 114,000 U.S.P. units of vitamin A daily for each calf. One group given an additional 129,400 U.S.P. units of vitamin A daily for 18 weeks gained an average of 235.9 lb in weight. The other group gained 187.6 lb, the difference in gain being significant. Inclusion of vitamin A in the ration significantly increased the vitamin A content of the blood plasma but decreased the carotene content.

Perry *et al*. (1962) reported increased appetite and feed efficiency by vitamin A supplementation to a ration for steer calves. When 10% lucerne was fed the vitamin A supplement had no beneficial effect. Gartner *et al*. (1962) reported similar findings.

III. MATERIALS AND METHODS

Due to the shortage of bull calves to be used for this experiment at the Agricultural Research and Education Center (AREC), additional calves were purchased from neighbouring farms. The calves were fed milk and a calf starter along with alfalfa hay, which was fed free choice, up to 90 days of age.

Twenty-two bull calves were paired according to age, weight and breed and 1 member of the pair assigned to group A, the other to group B. Calves in group A were castrated at approximately 80 days of age and those in group B were left as bulls. Since calves of the same age could not be obtained, calves had to be added to the experimental groups from time to time as shown in Table 1.

Housing

The 2 groups of experimental animals were housed in 2 separate pens with concrete floors, each with an approximate area of 30' x 20'. A wooden manger (2' x 8') and 1 automatic waterer were provided for each pen. The pens were partly roofed for protection against sun and rain.

Table 1. Age, breed, date started on experiment and weights of group A (steers) and group B (bulls) calves at the start of the experiment.

Group A					Group B				
No.	Breed	Date started on experiment	Age (days)	Weight (lb)	No.	Breed	Date started on experiment	Age (days)	Weight (lb)
123	C[1]	5-4-65	184	376.6	112	H.F.	5-4-65	167	400.0
120	C	5-4-65	153	391.6	110	C	5-4-65	152	366.0
118	H.F.[2]	5-4-65	115	263.6	108	H.F.	5-4-65	105	265.0
117	H.F.	5-4-65	97	194.6	104	H.F.	5-4-65	78	159.0
122	H.F.	12-4-65	82	203.3	111	H.F.	12-4-65	80	220.3
121	H.F.	24-5-65	118	252.0	106	R.D.	24-5-65	93	191.0
114	R.D.[3]	24-5-65	93	152.0	109	H.F.	24-5-65	90	200.0
116	H.F.	31-5-65	97	193.0	103	H.F.	31-5-65	91	149.0
115	H.F.	7-6-65	96	168.0	107	H.F.	7-6-65	88	178.0
113	R.D.	14-6-65	102	186.0	102	R.D.	14-6-65	100	214.0
119	R.D.	14-6-65	102	183.0	105	R.D.	14-6-65	97	184.0
Average			112.8	233.1				94.6	229.7

1 Holstein-Friesian calves which have some Shami blood.

2 Holstein-Friesian.

3 Red Danish.

Feeding Procedure

Both groups were fed an all-concentrate ration. The ingredients of the concentrate mixture used in this experiment are presented in Table 2 while its proximate and mineral analysis is presented in Table 3.

During the last 32 days of the experiment, peanut oil meal was not available and had to be substituted by linseed oil meal. Barley was reduced from 25 to 20 percent, and 15 percent linseed oil meal was added to maintain crude protein percentage at the previous level. Feed was offered every morning, and the amount was adjusted daily so that no feed refusal occurred or only meager amounts were left.

Weighings

Both groups were weighed at 30-day intervals.

Vitamin A Treatment

Since the experimental feed was practically devoid of vitamin A and carotene, it was decided to study the effect of 2 levels of vitamin A supplementation. Six animals in each group were injected intramuscularly with 5 cc (500,000 I.U.) at monthly intervals of a vitamin A solution[1] and the remaining 5 were given ½ that dose.

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1. Vitamin A water-miscible, courtesy Hoffman - La Roche and Co., Basle, Switzerland.

Table 2. Composition of the concentrate mixture.

Ingredients	Percentage
Beet pulp dried	45.0
Barley	25.0
Wheat bran	20.0
Peanut oil meal, 50% protein	10.0
Salt	0.5
Limestone	0.5

Table 3. Proximate and mineral analysis of the concentrate mixture.

	Analysis %
Total moisture	9.63
Crude protein	14.80
Crude fiber	14.77
Ether extract	1.68
Total ash	5.75
Nitrogen free extract	53.37
Calcium	0.68
Phosphorus	0.46

Slaughter of Animals

The animals were slaughtered when they reached 900 lb body weight. Some of the animals however, had not reached this weight at the time the experiment was to be terminated, and had to be butchered earlier. One animal in each group did not attain 700 lb at slaughter time. These animals were switched to a different ration at the termination of the experiment, hence, no slaughter data or liver carotene and vitamin A values were obtained. The average slaughter weight for steers was only 867.74 lb, which they reached after 267.7 days of feeding. The corresponding figures for bulls were 875.70 lb and 255 days.

Carotene and Vitamin A Analysis of Blood Serum and Liver

Blood was drawn from vena jugularis and was left to clot.

The analytical procedure described by Kimble (1939) for serum carotene and vitamin A determination was used. Ten cc of serum were thoroughly mixed with 10 cc of 95% ethyl alcohol and 30 cc of petroleum ether and kept overnight in the refrigerator. The next day 10 cc of the supernatent were transferred to a special Lumetron tube and the % transmission determined in the Lumetron colorimeter using a 460 millimicron filter. After this reading for carotene, the tube was placed in a water bath at

40-43°C for the evaporation of the petroleum ether. The evaporation was enhanced by running a current of dry air into the tube. After evaporating the ether, 1 cc of chloroform and 9 cc of a 25% antimony trichloride solution were added, and the intensity of the blue color resulting from the reaction of the antimony trichloride with the vitamin A was determined at a wave length of 620 $m\mu$.

Liver samples were taken when the animals were slaughtered. Determination of carotene and vitamin A were made according to the method of Stanley et al. (1954). Three to 5 gm of liver tissue was ground in a mortar with 3-5 times its weight of anhydrous sodium sulfate until it was completely dry. The dry powder was transferred quantitatively to a 250 cc volumetric flask and 100 cc peroxide-free anhydrous ethyl ether was added and shaken for 2 minutes. It was then set aside for a few hours, and an aliquot of 10 cc of the ether layer was transferred into a Lumetron tube and the percent transmission determined. Liver vitamin A determination was made similarly to that of blood serum, following the carotene determination.

Slaughter and Carcass Data

After dressing, the carcass was split along the backbone as accurately as possible into 2 equal halves. The carcass was then washed with warm water, weighed and transferred to a cooler operating at 32-34°F for an aging period of 7 days. Following aging the following carcass measurements were taken:

1. Length of carcass as measured from the frontal edge of the first rib to the tip of the aitch bone.

2. Depth of the carcass at 6th rib.

3. Maximum circumference of the round.

4. Thickness of fat over the mid point of the longissimus dorsi muscle at an incision made between 12th and 13th rib.

5. Length and depth of the same muscle at same site.

6. Rib eye area.

After aging the carcass was divided into the regular U.S. wholesale cuts as described by Bull (1951). The weight of each cut was recorded in pounds and percentages of the dressed carcass.

The 9-10-11th rib section was taken from the wholesale rib cut and carefully separated into lean, fat and bone. The percentage of lean, fat and bone in the whole carcass was calculated according to the formulae developed by Hopper (1944).

IV. RESULTS AND DISCUSSION

Live Weight Gains

Individual total gain and average daily gain for steers and bulls are shown in Tables 4 and 5. Steers gained 2.29 ± 0.44 pounds daily as compared with 2.56 ± 0.51 pounds for bulls. The difference in average daily gain was not significant when all animals were included. Since 2 of the steers, numbers 113 and 119, were suffering from chronic bloat and 2 of the bulls, numbers 102 and 106, were suffering from severe lameness, the analysis of variance was calculated without using the values of these 4 animals. After discarding the daily gain values of these 4 animals the average daily gain for bulls became 2.75 ± 0.33 pounds and for steers 2.45 ± 0.25 pounds. The difference was statistically significant as shown in Table 6. The average daily gain in both groups was higher than the value 2.0 pounds reported by Kercher and Bishop (1963) for steers fed beet pulp and alfalfa hay. The gains are also somewhat higher than those of Ivanov and Zahariev (1962) who reported average daily gains of 2.09 and 2.33 pounds in steers and bulls, respectively.

Table 4. Individual daily gains for steers on high and low vitamin A levels.

No.	Experimental days	Initial wt. (lb)	Final wt. (lb)	Total gain (lb)	Average daily gain (lb)
High vit. A level					
114	283	152.0	857.0	705.0	2.49
115	301	168.0	802.6	634.6	2.11
118	226	263.6	902.5	638.9	2.83
119	294	183.0	704.0	521.0	1.77
120	198	391.6	913.0	521.4	2.63
122	284	203.3	900.0	696.7	2.45
Average					2.38
Low vit. A level					
113	294	186.0	581.7	395.7	1.35
116	280	193.0	875.0	682.0	2.44
117	273	194.6	896.0	629.0	2.30
121	314	252.0	910.0	658.0	2.09
123	198	376.6	913.0	538.1	2.72
Average					2.18
Total Average	267.7	233.1	867.4		2.29 ± 0.44

Table 5. Individual daily gains for bulls on high and low vitamin A levels.

No.	Experimental days	Initial wt. (lb)	Final wt. (lb)	Total gain (lb)	Average daily gain (lb)
High vit. A level					
104	296	159.0	900.5	741.2	2.50
105	271	184.0	862.0	678.0	2.50
106	348	191.0	802.6	611.6	1.76
107	287	178.0	875.0	697.0	2.43
109	268	200.0	896.5	896.5	2.60
112	165	400.0	901.0	501.0	3.04
Average					2.47
Low vit. A level					
102	294	214.0	701.3	487.3	1.66
103	282	149.0	814.0	665.0	2.36
108	220	265.0	903.0	638.0	2.90
110	172	366.0	896.0	530.0	3.08
111	206	220.3	907.0	686.7	3.33
Average					2.67
Total Average	255	229.7	875.7		2.56 ± 0.51

Table 6. Analysis of variance of daily gain.

Source	d.f.	S.S.	M.S.	F
Total	17	1.77		
Between steers and bulls	1	0.399	0.399	4.7*
Within steers and bulls	16	1.371	0.086	

* Significant ($P < 0.05$).

Low and High Vitamin A Level

The daily gain of steers and bulls on high and low vitamin A levels are shown in Tables 4 and 5 and Figure 1. Steers on the high vitamin A level gained 2.38 pounds daily as compared with 2.18 pounds for steers on the low vitamin A level. Bulls on high vitamin A had an average daily gain of 2.47 pounds as compared with 2.67 pounds for bulls on low vitamin A. These findings differ from those of Ross and Knodt (1948), who reported higher gain in animals receiving 243,400 I.U. of vitamin A daily in the feed than animals receiving only 114,000 I.U. The 2 groups had a daily gain of 1.87 and 1.48 pounds, respectively.

No clinical signs of vitamin A deficiency were encountered and it appears that 250,000 I.U. of vitamin A were sufficient for satisfactory growth during the experimental period.

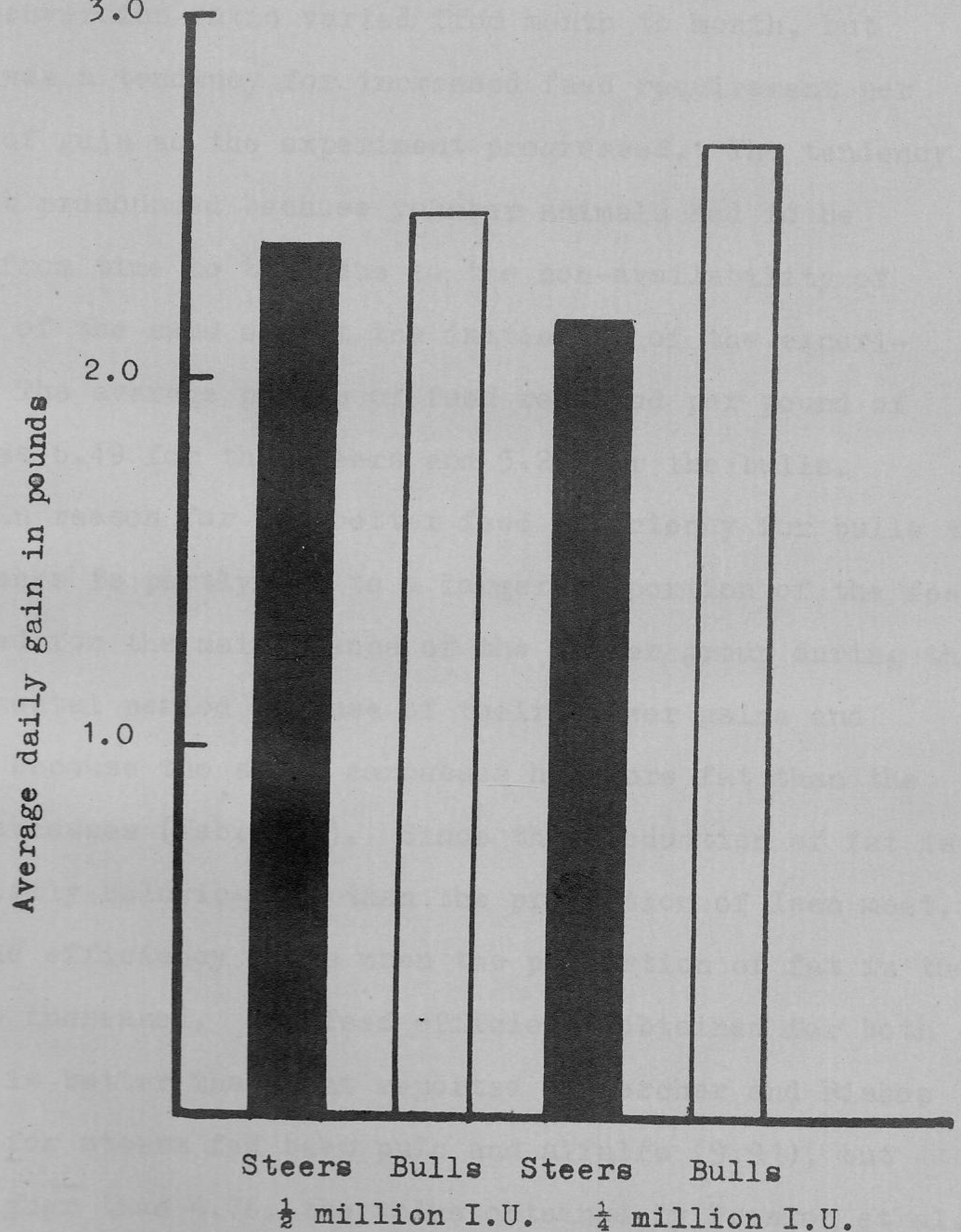

Figure 1. Average daily gains for steers and bulls on high and low vitamin A.

Feed Efficiency

The amount of feed required per pound of gain for the whole experimental period is shown in Figure 2. The feed conversion ratio varied from month to month, but there was a tendency for increased feed requirement per pound of gain as the experiment progressed. The tendency was not pronounced because younger animals had to be added from time to time due to the non-availability of calves of the same age at the initiation of the experiment. The average pounds of feed required per pound of gain was 6.49 for the steers and 5.20 for the bulls. The main reason for the better feed efficiency for bulls than for steers is partly due to a larger proportion of the feed required for the maintenance of the latter group during the experimental period because of their slower gains and partly because the steer carcasses had more fat than the bull carcasses (Table 13). Since the production of fat is more costly caloric-wise than the production of lean meat, the feed efficiency drops when the proportion of fat in the gain is increased. The feed efficiency obtained for both groups is better than that reported by Kercher and Bishop (1963) for steers fed beet pulp and alfalfa (9.91), but much higher than 4.76, the value obtained by Preston _et al_. (1963) for barley fed cattle.

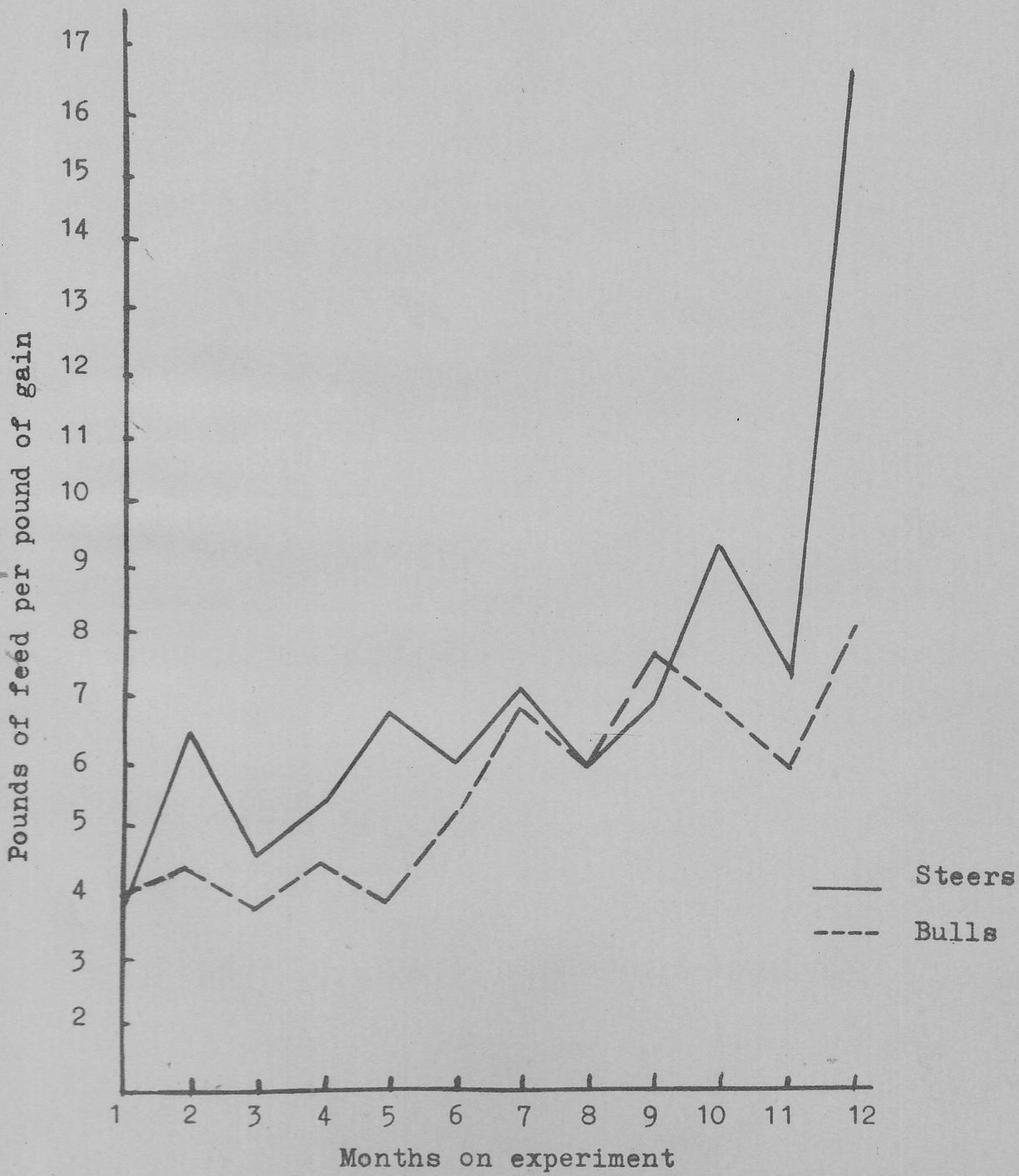

Figure 2. Feed efficiency for steers and bulls.

Carotene and Vitamin A in Blood Serum

The carotene and vitamin A levels in blood serum and liver are shown in Table 7.

The average carotene level for animals on high vitamin A dose was 9.14 ± 3.37 mcg/100 ml whereas the corresponding value for animals on low dose was 8.12 ± 3.62 mcg/100 ml. The average vitamin A levels were 54.77 ± 96.26 mcg/100 ml and 19.01 ± 17.37 mcg/100 ml for high and low vitamin dose, respectively. The higher standard error in both groups is due to individual differences. Calf number 114, on high dose, had the very high serum value of 359.29 mcg/100 ml which can be explained by the fact that this animal by mistake was injected 2 days before butchering. The vitamin A values in blood serum obtained in this study are much higher than 10-16 mcg/100 cc reported by Cunha (1964) for animals on a vitamin A deficient feed, but lower in animals on low dose than 30-50 mcg/100 ml reported by this author for animals on a vitamin A adequate feed.

Carotene and Vitamin A in Liver

The average carotene level in liver of animals on high vitamin A dose was 120.69 ± 61.54 mcg/100 gm and 118.12 ± 32.98 mcg/100 gm for animals on low dose. The

Table 7. Vitamin A and carotene in blood serum and liver of steers and bulls.

	500,000 I.U.					250,000 I.U.			
No.	Blood		Liver		No.	Blood		Liver	
	Vit. A[1]	Carotene[2]	Vit. A[3]	Carotene[4]		Vit. A	Carotene	Vit. A	Carotene
				Group A (Steers)					
114	359.29	10.75	23.40	105.41	113	29.46	12.90	-	-
115	35.93	12.90	26.15	90.08	116	58.53	8.60	5.35	104.90
118	14.78	8.60	5.68	141.33	121	7.25	10.75	1.64	107.97
119	17.47	10.75	15.52	14.13	123	13.50	8.60	0.95	178.28
120	24.27	4.30	3.78	121.46					
122	26.72	8.60	6.30	105.39					
Ave.	79.74	9.32	13.47	96.30		27.18	10.21	2.65	130.38
				Group B (Bulls)					
104	20.42	4.30	6.37	204.01	102	13.50	8.60	-	-
105	37.72	6.45	27.34	86.81	103	29.74	10.75	1.71	76.24
106	27.84	15.05	2.34	73.18	108	19.14	4.30	1.29	96.48
107	43.58	15.05	9.18	99.96	110	0	0	0.11	126.44
109	25.55	4.30	11.86	261.03	111	0	8.60	0.07	136.52
112	23.65	8.60	5.61	145.54					
Ave.	29.79	8.96	10.45	145.08		12.47	6.45	0.79	108.92
Total ave.	54.77	9.14	11.96	120.69		19.01	8.12	1.59	118.12

1 mcg/100 ml.
2 mcg/100 ml.
3 mg/100 gm.
4 mcg/100 gm.

vitamin A level for high and low dose was 11.96 ± 8.61 mg/100 gm and 1.59 ± 1.79 mg/100 gm liver tissue. The difference in vitamin A level was highly significant (Table 8). The mean liver vitamin A values in both groups were higher than 0.1 to 0.4 mg/100 gm, the range reported by Cunha (1964) for animals on a vitamin A deficient ration, and within the range of 0.9 to 4.2 mg/100 gm suggested by Moore and Payne (1942) for cattle fed diets adequate in vitamin A.

Carcass Data of Steers and Bulls

Dressing percentage and rib-eye area. The dressing percentage and rib-eye area are shown in Table 9. The average dressing percentage in steers was 59.46 ± 1.74 with a range from 56.32 to 62.34. The steers with high carcass scores had the highest dressing percentages. The bulls had an average dressing percentage of 59.21 ± 1.18 with a range from 56.10 to 60.40, or approximately the same as the steers. Richter *et al.* (1961) reported 0.8 percentage unit higher dressing percentage in steers than in bulls. The average rib-eye area in steers was 71.10 ± 5.14 cm^2 (range 65.38 to 83.54), while bulls had an average rib-eye area of 81.53 ± 7.78 (range 74.38 to 96.54). Thus the rib-eye area in case of bulls was 14.67% larger than that of steers. This difference was highly significant as shown in Table 10.

Table 8. Analysis of variance of vitamin A in liver.

Source	d.f.	S.S.	M.S.	F
Total	18	1386.40		
Between high and low vitamin A group	1	475.60	475.60	8.87**
Within high level and within low level	17	910.80	53.60	

** Highly significant ($P < 0.01$).

Table 9. Dressing percentage and rib-eye areas in steers and bulls.

Steers			Bulls		
No.	Dressing %	Rib-eye area cm^2	No.	Dressing %	Rib-eye area cm^2
114	57.40	83.54	103	60.31	86.31
115	58.31	65.38	104	59.40	77.42
116	62.34	71.53	105	60.09	96.54
117	60.70	69.61	106	59.06	93.60
118	60.60	70.21	107	60.00	75.00
119	56.32	65.38	108	58.80	77.38
120	59.20	70.76	109	60.40	76.80
121	60.66	74.23	110	58.93	80.23
122	60.60	71.52	111	56.10	77.60
123	58.60	68.92	112	59.04	74.38
Average	59.46	71.10		59.21	81.53

Table 10. Analysis of variance for rib-eye area.

Source of variation	d.f.	S.S.	M.S.	F
Total	19	1342.12		
Between bulls and steers	1	542.68	542.68	12.22**
Within sex (steers and bulls)	18	799.45	44.41	

** Highly significant ($P < 0.01$).

Percentage of wholesale cuts. The wholesale cuts for individual animals and the average for the group are shown in Tables 11 and 11a. Only the percentage of rounds and chucks were higher in the bulls than in the steers, but in none of the other cuts was there a significant difference between steers and bulls.

Carcass measurements. The carcass measurements are given in Table 12. Steers had slightly longer carcasses than bulls, with measurements of 116.89 and 113.69 cm, respectively. The depth of the carcass and the circumference of rounds was also greater in the steers. Length and width of rib eye was slightly greater in bulls. None of the difference, however, was significant.

Carcass composition. The carcass composition, estimated by using formulae developed by Hopper (1944) is given in Table 13. Average fat percentage in steers and bulls was 27.83 $\pm$ 3.64 and 20.75 $\pm$ 1.80, respectively. The difference was highly significant (Table 14). The average lean percentage for steers was 56.13 $\pm$ 3.35 and for bulls 63.27 $\pm$ 2.28. This difference was again highly significant (Table 15). The bone percentage in steers and bulls was 15.99 and 15.97, respectively.

Visual inspection of carcasses showed more fat cover and marbling of rib eye of steer carcasses. The results agree with those of Ivanov and Zahariev (1962) and Prescott

Table 11. Percentage of wholesale cuts in steers.

Steer	Rounds	Sirloin	Short loin	Flanks	Ribs	Chucks	Fore shank	Plates	Brisket
120	23.45	8.71	7.39	5.98	9.71	24.00	7.18	7.38	6.20
123	24.85	9.29	7.68	4.24	10.00	23.54	7.47	6.67	6.26
118	24.06	9.38	6.93	6.01	7.64	23.54	7.54	7.12	7.75
122	26.21	9.22	7.28	4.85	9.13	21.46	7.96	7.48	6.41
117	25.78	8.88	7.62	5.36	10.16	22.26	6.44	7.84	5.66
116	24.14	8.83	7.85	5.30	10.00	23.16	7.08	7.46	6.18
114	23.60	9.01	7.51	5.36	10.08	24.68	6.22	7.51	6.03
121	23.94	9.02	6.99	6.99	9.58	22.84	6.63	7.93	6.08
115	23.73	8.36	7.12	5.65	11.41	22.15	7.46	7.57	6.55
119	26.02	8.94	7.05	5.69	9.76	23.31	7.45	6.64	5.15
Average									
	24.58	8.96	7.34	5.54	9.75	23.09	7.14	7.36	6.23

Table 11a. Percentage of wholesale cuts in bulls.

Bull	Rounds	Sirloin	Short loin	Flanks	Ribs	Chucks	Fore shank	Plates	Brisket
112	25.80	8.20	6.20	5.40	9.30	24.60	7.80	6.79	6.00
110	25.40	8.32	7.51	5.01	9.62	24.41	7.21	7.11	5.41
111	27.62	8.24	7.02	4.26	9.33	24.46	7.07	6.78	5.22
108	26.20	9.05	7.13	4.62	10.40	23.89	7.13	6.26	5.32
109	26.84	8.75	6.76	4.57	9.34	23.26	7.26	7.06	6.16
104	26.35	8.78	7.97	5.62	7.97	24.72	5.41	7.25	5.93
105	27.40	8.79	5.93	3.88	9.01	25.36	6.95	6.34	6.34
107	25.65	8.62	7.01	4.01	9.42	25.45	7.41	6.81	5.62
106	24.56	8.85	6.86	5.31	9.51	24.34	7.52	6.86	6.19
103	24.83	8.35	7.36	5.71	10.11	23.21	6.81	7.25	6.37
Average									
	26.06	8.59	6.97	4.84	9.40	24.37	7.06	6.85	5.86

Table 12. Carcass measurements (centimeters).

No.	Length	Depth	Circumference of rounds	Length of rib-eye	Width of rib-eye
Steers					
120	118.0	58.0	107.0	12.9	6.2
123	118.0	60.0	106.0	12.7	6.7
118	116.0	57.5	110.5	12.0	6.0
122	116.5	63.0	113.0	13.8	7.8
117	119.0	59.0	116.0	12.0	6.5
121	114.0	63.0	112.0	12.7	6.6
114	122.3	59.0	105.0	14.0	6.6
116	116.5	60.3	107.4	13.9	6.5
119	113.2	58.5	98.3	12.2	7.5
115	115.4	58.7	104.2	13.0	6.4
Ave.	116.89	59.7	107.94	12.92	6.68
Bulls					
104	116.5	59.5	109.0	13.0	7.0
112	115.0	57.0	100.8	13.0	8.0
110	114.0	58.0	106.0	14.0	6.5
111	120.0	57.0	101.2	14.0	7.7
108	116.5	57.0	112.0	13.6	7.3
109	118.0	60.0	108.0	13.5	7.4
103	105.3	58.0	101.4	14.0	7.0
105	109.0	59.3	106.5	15.5	7.3
107	108.4	59.5	107.2	14.0	6.5
106	114.2	61.3	104.5	15.0	6.5
Ave.	113.69	58.66	105.66	13.96	7.12

Table 13. Carcass score and percentage of fat, lean and bone in whole carcass calculated on the basis of the fat, lean and bone in 9-10-11 rib cut.

Steers					Bulls				
No.	% fat*	% lean**	% bone***	Carcass score	No.	% fat	% lean	% bone	Carcass score
120	30.52	53.24	15.70	Good	109	22.40	61.60	16.00	Good
123	30.50	52.70	16.80	Good	108	22.50	61.30	16.20	Good
118	32.20	52.80	15.00	Choice	112	17.70	64.60	17.70	Good
122	27.90	56.50	15.60	Choice	111	24.70	58.80	16.50	Good
117	33.50	51.00	15.50	Choice	110	22.80	62.20	15.00	Good
121	27.59	55.80	16.61	Good	104	20.30	62.20	17.50	Good
114	25.08	59.66	15.26	Good	103	20.62	64.44	14.94	Good
116	25.49	59.58	14.93	Choice	105	19.80	65.94	14.26	Good
119	21.91	59.83	18.26	Good	107	18.74	66.06	15.20	Good
115	23.57	60.17	16.26	Choice	106	17.99	65.54	16.43	Good
Ave.	27.83	56.13	15.99	Low choice		20.75	63.27	15.97	Average good

* $y = 0.81774x + 2.27664$ for % of fat in whole carcass.
** $y = 0.80173x + 15.71220$ for % of lean in whole carcass.
*** $y = 0.70750x + 3.47863$ for % of bone in whole carcass.

Where x is the % of the particular component in the 9-10-11 rib section and y is the estimated % of that component in the whole carcass.

Table 14. Analysis of variance on fat percentage in steers and bulls.

Source	d.f.	S.S.	M.S.	F
Total	19	429.57		
Between steers and bulls	1	249.99	249.99	25.06**
Within steers and bulls	18	179.58	9.976	

** Highly significant ($P < 0.01$).

Table 15. Analysis of variance on lean percentage in steers and bulls.

Source	d.f.	S.S.	M.S.	F
Total	19	419.20		
Between steers and bulls	1	259.50	259.50	29.76**
Within steers and bulls	18	159.70	8.87	

** Highly significant ($P < 0.01$).

and Lamming (1964) who reported more abdominal and internal fat in steers than in bulls.

Disease Incidence

The concentrate mixture fed had a laxative effect on both groups throughout the experiment. Two of the steers showed signs of chronic bloat which was presumably due to lack of roughage in the feed. Severe diarrhea and bloat in animals fed high levels of beet pulp has been observed by Charton (1954). Lameness was observed in 2 bulls which may be attributed to the highly concentrated feed.

Liver abscesses were observed in 2 steers, numbers 116 and 119 and 2 bulls, numbers 103 and 105. In 1 of the bulls and 1 of the steers, the liver abscesses were extended to involve not only the liver but also the diaphragm and the lung. These abscesses are often found in animals on high cereal rations, but Manuelian (1965) reported liver abscesses in animals fed beet pulp silage and no abscesses when dried beet pulp was fed. Several causes of these abscesses have been suggested. Fincher (1956) and Harris (1962) have suggested that high cereal feeding produces a low pH in the rumen and this may damage the mucosa and facilitate the entrance of bacteria into the portal blood. Harris has also stated that there is so far no means of control of this condition. The gross appearance of the affected liver varies considerably. In some cases there are discrete foci of necrosis, while in others abscesses are scattered all over the liver. Bacteriological examination has demonstrated Corynebacterium pyogenes, Bacillus necrophorus, Actinomyces necrophorus and others as causative bacteria.

Smith and Jones (1958) have reported occasional death of animals due to liver abscesses after showing acute digestive symptoms. Clinical symptoms of liver abscesses are seldom observed.

There was no death loss among experimental animals.

Economical Analysis

The cost of calves, feed, labor and housing were added up in calculating total cost of production. Net profit per bull and steer was obtained by deducting total cost from selling price. Tables 16 and 17 show a detailed account of cost and net profit for steers and bulls.

Table 16. Feed prices, feed consumption and total feed cost from birth to slaughter for steers and bulls.

Item	Price (PL/lb)	Total consumption (lb)		Total cost (LL)	
		Steers	Bulls	Steers	Bulls
Pre-experimental period					
Milk	13.7	913.0	902.0	124.50	123.00
Hay	13.7	195.8	158.4	26.70	21.60
Concentrate	8.2	180.4	162.8	14.72	13.32
Experimental period					
Concentrate		3891.8	3268.10	288.35	242.14

Table 17. Major cost items and profitableness per steer and bull.

Item	Group A (steers)	Group B (bulls)
Cost of calf (LL)	80.00	80.00
Feed cost (pre-experimental period) (LL)	165.92	157.92
Labor and housing (pre-experimental period) (LL)	7.26	6.74
Total initial cost per animal (LL)	253.18	244.66
Cost of concentrate (experimental period) (LL)	288.35	242.14
Labor and housing (experimental period) (LL)	26.77	25.54
Total cost per animal (LL)	568.30	512.34
Return per animal*	737.70	709.10
Net profit	169.40	196.76

* L.L. 1.39 per pound for steer carcass and 1.32 per pound for bull carcass.

V. SUMMARY AND CONCLUSIONS

1. Eleven steers and 11 bulls were fattened on an all-concentrate ration containing 45% dry molasses beet pulp. Slight diarrhea in all animals and bloat in 2 steers were observed. Two of the bulls showed chronic lameness.

2. The average daily gain in steers was 2.29 ± 0.44 pounds and in bulls 2.56 ± 0.51 pounds. No difference was observed in daily gains between the intramuscular injection of 2 levels of vitamin A ((500,000 I.U. and 250,000 I.U.).

3. Feed efficiency was better in bulls than steers. Bulls required 5.20 ± 1.34 pounds of feed per pound of gain, whereas steers required 6.40 ± 0.80 pounds.

4. Steers had fatter carcasses than bulls. Fat percentage in steer carcasses averaged 27.83 ± 3.64 and in bulls 20.75 ± 1.80, the difference being highly significant. Lean percentage in steers was 56.13 ± 3.35 and 63.27 ± 2.28. This difference was also highly significant. Dressing percentage was 59.46 and 59.21 for steers and bulls, respectively.

5. Liver abscesses were found in 4 animals, in 2 of these the diaphragm and lungs were also involved.

6. The average carotene value in blood serum for animals on high vitamin A level was 9.14 ± 3.73 mcg/100 ml as compared with 8.12 ± 3.52 for the animals on the lower dose. Average vitamin A content of the livers was 54.77 ± 96.26 mcg/100 ml and 19.01 ± 17.37 for animals on the high and low levels of vitamin injections, respectively. The average liver carotene values for the high and low vitamin A levels were 120.69 ± 61.54 and 118.12 ± 32.98 mcg/100 gm, respectively. Liver vitamin A levels were 11.96 ± 8.61 mg/100 gm for animals on the high vitamin A level and 1.59 ± 1.79 for the animals on lower dose. This difference was highly significant ($P < 0.01$).

7. Based on current prices the net profit for bulls was L.L. 196.76 and L.L. 169.40 for steers.

LITERATURE CITED

Bull, Sleeter. 1951. Meats for the Table. McGraw Hill Company, Inc. New York.

Charton, A. 1954. Disturbances in ruminants caused by sugar beet pulp (Translated Summary). Rec. Med. Vet. 130: 761-776.

Cunha, T.A. 1964. More vitamin A for beef cattle. World Farming. 6: 8, 26.

Fincher, M.G. 1962. Diseases of Cattle. American Veterinary Publications, Inc. Evanston, Illinois.

Gartner, R.J.W., and J.W. Ryley. 1962. Relationship between nyctalopia and plasma vitamin A levels and the effect of vitamin A supplementation in beef calves. Queensland J. Agric. Sci. 19: 363-372. Abstracted in Nutrition Abstracts and Reviews (4218). Vol. 33, 1963.

Hale, W.H., F. Hubbert, R.E. Taylor, T.A. Anderson, and B. Taylor. 1962. Performance and tissue vitamin A levels in steers fed high levels of vitamin A. An. J. Vet. Res. 23: 992-996.

Harris, A.H. 1962. Apparent hazards of high barley feeding to cattle. Vet. Rec. 74: 1434.

Homb, T. 1958. Comparison of castrated and entire bulls for beef production. Norges Lanbrukshogsk Breten Forings forsok, No. 87, 69-72. Abstracted in Nutrition Abstracts and Reviews (1235). Vol. 30, 1960.

Hopper, T.H. 1944. Methods of estimating the physical and chemical composition of cattle. J. Agric. Res. 68: 239-267.

Ivanov, P., and Z. Zahariev. 1962. Intensive fattening of bulls (Translated Summary). Mezdunarad Sel' skohoz. Z. No. 3, 76-81. Abstracted in Nutrition Abstracts and Reviews (6283). Vol. 32, 1962.

Kercher, C.J., and D.V. Bishop. 1963. The influence of all-concentrate feeding on the growth and carcass characteristics of beef cattle. J. Animal Sci. 22: 839.

Kimble, M.S. 1939. The photo colorimetric determination of vitamin A and carotene in human plasma. J. Am. Clini. Med. 24: 1055.

Manuelian, M. 1965. Comparative feeding trial of dried sugar beet pulp vs sugar beet pulp silage for fattening young bulls. M.S. Thesis. Faculty of Agricultural Sciences, American University of Beirut. Beirut, Lebanon.

Ministry of Agriculture, Agricultural Statistics Division. 1964. "Agricultural statistic about area, production and value, 1964" (Mimeo). Beirut, Lebanon.

Moore, T., and J.E. Payne. 1942. The vitamin A contents of the livers of sheep, cattle and pigs. Biochem. J. 36: 34-36.

Perry, T.W., W.M. Beeson, M.T. Mohler, and W.H. Smith. 1962. Levels of supplemental vitamin A with and without sun cured alfalfa meal for fattening steer calves. J. Animal Sci. 21: 333-339.

Prescott, J.H.D., and G.E. Lamming. 1964. The effects of castration on meat production in cattle, sheep and pigs. J. Agric. Sci. 63: 341-357. Abstracted in Nutrition Abstracts and Reviews (4733). Vol. 35, 1965.

Preston, T.R. 1963. Barley beef production. Vet. Rec. 75: 1399-1402.

Richter, K., K.L. Grang, and K.H. Schmidt. 1961. Fattening studies with young bulls and bullocks. Further studies on the effect of late castration on fattening performance, slaughter value and carcass quality (Translated Summary). Zuchtungskunde, 33: 493-510. Abstracted in Nutrition Abstracts and Reviews (4565). Vol. 32, 1962.

Ross, R.H., and C.B. Knodt. 1948. The effect of supplemental vitamin A upon growth, blood plasma carotene, vitamin A, inorganic calcium and phosphorus of Holstein heifers. J. Dairy Sci. 31: 1062-1067.

Sadovnikova, N. 1959. Fattening cattle on beet pulp with urea. Mol. Mjas. Zivot. 2, 43-45. Abstracted in Nutrition Abstracts and Reviews (6568). Vol. 29, 1959.

Samman, M.A. 1964. Sugar beet seed production. M.S. Thesis. Faculty of Agricultural Sciences, American University of Beirut, Beirut, Lebanon.

Smith, H.A., and T.C. Jones. 1958. Veterinary Pathology. Lea and Febiger, Philadelphia.

Stanley, R. Ames, Hugh A. Risley, and Philip L. Harris. 1954. Simplified procedure for extraction and determination of vitamin A in liver. Analytical Chem. 26: 1378.

Vezzani, V., and R. Raimondi. 1954. The influence of castration on somatic growth and on the character of the meat of fattening Piedmontese calves. Riv. Zootec. 27: 341-347. Abstracted in Nutrition Abstracts and Reviews (4295). Vol. 25, 1955.

Worzella, W.W., H.D. Fuehring, S. Abu Shakra, and A. Sayegh. 1962. Cultural practices, varieties and fertilizers on sugar beet production in Beka'a, Lebanon. Publication No. 16. Faculty of Agricultural Sciences, American University of Beirut. Beirut, Lebanon.