Conventional Versus High Concentrate Rations for Feeder Heifers and Steers

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AUTHORS: E. N. Hoffman is Superintendent, Malheur Experiment Station, Ontario, Oregon; W. H. Kennick is Assistant Professor of Animal Science, Oregon State University; P. H. Weswig is Professor of Agricultural Chemistry, Oregon State University; and J. E. Oldfield is Professor of Animal Science, Oregon State University.

CONVENTIONAL VERSUS HIGH CONCENTRATE RATIONS FOR FEEDER HEIFERS AND STEERS

E. N. Hoffman, W. H. Kennick, P. H. Weswig and J. E. Oldfield

There has been a marked trend in recent years towards use of high concentrate rations for feedlot cattle. Such rations, in which the roughage is replaced by fibrous grain components, are more highly digestible by the animals than conventional hay-grain mixtures; hence, weight gains are usually superior.

One of the first feedstuffs to serve in high concentrate rations was ground ear corn, in which the cob provided a source of fiber (Geurin, 1955). Later experiments involved other fibrous feeds, like oats, which worked satisfactorily when mixed 50:50 with ground shelled corn. Perhaps the most success has occurred when the entire ration has been made up of barley plus a protein supplement (Williamson, 1961; Pope, 1962). Montana tests recorded gains of about 3 pounds per head daily for heifers and 2.75 pounds daily for steers fed steam-rolled barley and protein supplement for 126 to 179 days (Thomas, 1962). Steer gains averaging 2.98 pounds per day were obtained in Oregon trials using wheat with various sources of fiber diluent (Ralston, Kennick and Davidson, 1964). Most subsequent experience with high concentrate rations has involved the use of protein supplements; yet additional protein is not entirely consistent with the requirements of finishing cattle as listed by the National Research Council (1964).

In the Ontario area of eastern Oregon, three fibrous concentrate feeds--ground ear corn, rolled barley, and dried beet pulp--are readily available. This report describes experiments in which these feeds were combined with or without additional protein in so-called "high concentrate" rations for both heifers and steers being finished for slaughter. It also compares performance of these cattle with that of cattle on a conventional hay-grain ration.

Method

Two years' experiments are reported, and the general experimental plan is shown in Figure 1. In each of these years, three groups each of yearling heifers and steers from the same herd were fed on the rations described in Table 1. The animals were fed in similar pens with some cover provided over the feed bunks. Water and steamed bonemeal were offered *ad lib*. Lots 1 through 4 received 750 I.U. of vitamin A per pound of feed. Two percent salt was added to their grain feed in an effort to prevent incidence of urinary calculi which had previously proved troublesome under similar diet conditions. The protein supplement, where used, was fed at the rate of 1 pound supplement:10 pounds grain. These four lots on high-concentrate feed were given long alfalfa hay in decreasing amounts during the first three weeks of feeding to get them gradually accustomed to the high-concentrate feed. Lots 5 and 6 were fed a conventional ration of ground

ear corn and long alfalfa hay that has been standard at the Malheur Station for many years. Half the animals in each group were implanted with 36 milligrams of diethylstilbestrol (DES) at the beginning of the trial period.

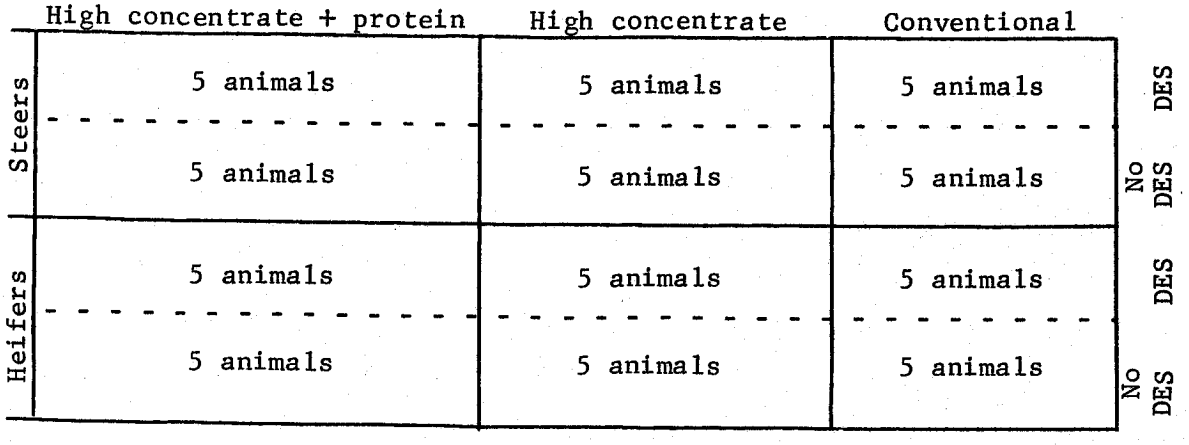

Figure 1. Experimental ration treatments.

Each year, the heifers were fed for a shorter period than the steers. The first year, all heifers were slaughtered after 132 days and all steers after 174 days. Because of heavy starting weights, however, and greater than anticipated rates of gain, this procedure resulted in excessively heavy carcasses. The second year, heifers were slaughtered at weights of 975 to 1,000 pounds and steers at 1,175 to 1,200 pounds. This resulted in feeding periods of 84 to 133 days for the heifers and 119 to 161 days for the steers.

TABLE 1. Ration Composition and Protein Content

Lot No.	1	2	3	4	5[a]	6[a]
Ingredient	%	%	%	%	%	%
Steam-rolled barley	50	50	50	50		
Ground ear corn	25	25	25	25	75	75
Dried beet pulp	25	25	25	25		
Protein supplement[b]	Yes	Yes	No	No	No	No
Long alfalfa hay					25	25
Estimated ration protein, %	12	12	10	10	9	9

[a] Proportions in rations 5 and 6 are approximate averages throughout the feed period. Animals in these lots were started heavy on hay and finished heavy on grain, in the conventional feeding manner.

[b] Protein supplement consisted of: alfalfa meal, 50%; soybean oil meal, 50%.

Weather varied considerably during the two test-year feeding periods, but in neither year was it considered a significantly adverse factor. Precipitation was slight and was mostly in the form of snow. Lots did not become excessively muddy, since temperatures were usually below freezing. At the conclusion of each year's test, the animals were marketed through a local commercial packing plant[1] where arrangements had been made to assemble carcass data. Liver samples were obtained at slaughter the first year of the trial.

Results and Discussion

Since the animals were fed in groups, their feed intake and conversion data could not be statistically analyzed. Using average figures, however, animals on the conventional, hay-grain ration (Lots 5 and 6) required about 9 pounds of feed to produce a pound of gain, and those on the two high-concentrate rations (Lots 1 through 4) required about 7.5 pounds of feed per pound of gain. This difference reflects the different digestible nutrient contents of the hay-grain and high-concentrate rations.

The two high-concentrate rations produced significantly higher average daily gains than did the conventional ration. Although there was no significant increase in gain of all cattle attributable to protein supplementation (Table 2), there was evidence of some interaction between type of diet and sex of cattle ($P < 0.10$).[2] Data in Table 2 indicate that heifers are more sensitive to varying rations than steers. The protein supplement increased rate of gain in heifers and not in steers, and the control ration depressed rate of gain in heifers more than it did in steers. It would appear from the periodic rates of gain presented in Table 3 that the primary effect of protein supplementation in heifers took place during the first four weeks of the feeding period. This effect was of sufficient magnitude to be effective throughout the feeding period, as evidenced by the cumulative rates of gain. These data also indicate that the conventional ration was as good a starting ration as was the high-concentrate ration. Further research would be necessary to determine whether the cattle can be switched from one ration to the other and maintain their particular growth period rates-of-gain advantage.

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1 Wells and Davies; Payette, Idaho.

2 Probability levels listed throughout show the extent of significance in the differences discussed, as determined by statistical analysis. For example ($P < 0.05$) indicates that in only 5 cases out of 100 would the differences observed be due to chance and not to the treatments imposed. This is usually considered a "significant" difference, meaning that it would be generally reproducible.

TABLE 2. Average Daily Gain (ADG) and Carcass Weight (CW) as Affected by Type of Feed, Sex and Stilbestrol Implantation

Item tested	Ration							
	High Conc. + protein		High Conc.		Conventional		Means	
	ADG	CW	ADG	CW	ADG	CW	ADG	CW
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1963	2.74	726.7	2.58	720.6	2.40	672.5	2.57[a]	706.6[a]
1964	3.06	637.3	3.08	631.2	2.80	626.4	2.98	631.6[e]
Steers	2.79	738.6	2.84	733.1	2.67	703.5	2.77	725.1[f]
Heifers[d]	3.01	625.4	2.82	618.7	2.52	595.4	2.79	613.2
Control	2.82	683.5	2.73	672.0	2.49	648.3	2.68[b]	667.9
Stilbestrol	2.98	680.5	2.94	679.8	2.70	650.6	2.87	670.6
Ration means	2.90	682.0	2.83	675.9	2.60[c]	649.5[c]		

a Significantly different than in 1964 ($P < 0.01$).
b Significantly different than Stilbestrol ($P < 0.01$).
c Significantly different than High-Concentrate rations ($P < 0.01$).
d Significant sex X ration interaction ($P < 0.10$).
e Significant year X ration interaction ($P < 0.05$).
f Significantly different than heifers ($P < 0.05$).

There was a highly significant difference in average daily gains between the two years, probably attributable to the shorter feed period used the second year (Table 2). This emphasizes the higher nutritional cost involved in carrying cattle to excessively heavy weights. Stilbestrol increased the average daily gains of steers and heifers by 0.27 and 0.11 pounds, respectively, over those of nonimplanted animals.

TABLE 3. Average Daily Gain by Four-Week Feed Periods[a]

Animals	Rations	Feed periods					
		1	2	3	4	5	6
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Steers	High Conc.+ Protein	2.66	3.95	2.74	2.91	1.80	2.12
	High Concentrate	2.21	4.48	2.95	2.50	2.23	2.52
	Conventional	3.48	3.03	2.18	2.50	3.10	1.60
Heifers	High Conc. + Protein	2.95	3.56	2.88	2.83	1.75	
	High Concentrate	1.81	4.01	2.78	1.94	2.87	
	Conventional	2.95	2.70	2.15	2.14	2.25	

a Periods 4 and 5 for heifers and 5 and 6 for steers include only 1963 data; most of the cattle were marketed by this time in 1964.

All treatment groups produced carcasses with at least average-choice conformation. However, there were some small but significant differences between years and sexes, as well as an interaction between the stilbestrol treatment and sex of animal. This latter was evidenced by the fact that stilbestrol improved conformation in heifers while reducing it in steers.

TABLE 4. The Effects of Sex, Treatment, and Year on Carcass Characteristics

Item tested	Conformation score[a]	Marbling score[b]	USDA grade[a]	Loin-eye area (sq. in)	Backfat thickness (mm)
Steer - control	17.90[c]	13.63	16.27[c]	12.63	12.53
Steer - stilbestrol	17.70	11.83	15.36	12.90	11.93
Heifers - control	16.73	11.70	15.20	12.14	11.60
Heifers - stilbestrol	17.07	11.10	15.13	12.13	11.70
Steers	17.80	12.73	15.81	12.77	12.23
Heifers	16.90[d]	11.40[e]	15.17[e]	12.14	11.65
1963	17.55	12.45	15.68	13.03	13.65
1964	17.15[e]	11.68	15.30[g]	11.87[e]	10.23[f]
Control	17.32	12.67	15.73	12.38	12.07
Stilbestrol	17.38	11.47[d]	15.25[d]	12.52	11.82
High Conc. + protein	17.28	12.15	15.50	12.56	12.78
High Concentrate	17.53	12.75	15.82	12.82	12.35
Conventional	17.25	11.30[g]	15.15[d]	11.97[f]	10.70[d]

[a] 14 = average good; 17 = average choice.
[b] 12 = average small; 15 = average modest.
[c] Significant sex X hormone treatment interaction ($P < 0.05$).
[d] Significantly different from comparable year or treatment ($P < 0.05$).
[e] Significantly different from comparable year or treatment ($P < 0.01$).
[f] Significantly different from comparable year or treatment ($P < 0.001$).
[g] Significantly different from comparable year or treatment ($P < 0.10$).

With uniform cattle of this type, marbling tends to be the factor which determines grade. It is interesting to note, therefore, that the small apparent difference in marbling attributable to the nutritional treatment is significant at the 10% level. The conventional, protein-supplemented, and unsupplemented, high-concentrate rations produced carcasses with small-minus, average-small, and small-plus amounts of marbling, respectively. There was no significant difference in marbling between years despite the shorter feed period of the second year. Stilbestrol reduced the amount of marbling in steers by approximately one-half of a degree.

The combination of effects on conformation and marbling produced small (less than one-third of a grade) but significant differences in USDA carcass grade; heifers graded lower than steers, implanted steers graded lower than unimplanted steers (Table 4), and cattle on the control ration graded lower than those on the high-concentrate ration (Table 4). There was no significant difference in USDA grade attributable to protein supplementation, nor in heifers as a result of stilbestrol implantation.

Two of the factors which are used to estimate carcass cutout values are loin-eye area and thickness of fat over the loin eye. There was a highly significant difference in loin-eye area associated with years and ration which may be accounted for by differences in carcass weight since the loin-eye areas per hundred weight of carcass are almost identical. The heifers, however, had a greater loin-eye area per hundred weight (1.98 sq. in.) than did the steers (1.76 sq. in.).

There was a highly significant reduction in fat thickness in the second year (1.62 mm/cwt) as compared to the first year (1.93 mm/cwt) when the cattle were fed to a heavier weight. Also, the high-energy rations produced thicker fat (1.85 mm/cwt) than did the control ration (1.65 mm/cwt). This is partially accounted for by the fact that in both years heifers were fed for a shorter period of time than steers and that the steers were fed for a shorter period the second year than the first. These shorter feed periods produced lighter cattle with less finish, and since both of the characteristics are negatively associated with yield of trimmed cuts, these reductions would be expected to produce carcasses with a higher yield of trimmed cuts.

Considerable interest has been shown in supplementing feedlot rations with vitamin A. Two points in particular seem important. First, there has been some question regarding the efficiency with which cattle can convert carotene in natural feedstuffs, such as alfalfa hay, into vitamin A. Second, it has been recognized that many high-concentrate rations, where most if not all of the hay has been removed, require supplementation with vitamin A. The comparison of performance on rations 1-4, which were supplemented with 750 I.U. of vitamin A per pound, with that on rations 5 and 6, which contained alfalfa hay, is, therefore, interesting. While extremes in vitamin A nutrition are reflected in changes of growth rate, a more sensitive measurement of the animals' status is given by vitamin A analysis of the liver, which is the storage site for this and other vitamins. Liver samples were obtained from each animal at slaughter in the first test year and were analyzed for both β-carotene and vitamin A, with the results shown in Table 5.

Apparently, the carotene supplied by the alfalfa hay in the conventional rations was effectively used by the cattle, resulting in higher liver levels of vitamin A than occurred on the high-concentrate rations. The liver vitamin A levels in the high-concentrate ration-fed steers, although lower than on the conventional ration, were satisfactory when compared to Oklahoma data (Church, 1956). Difficulty in maintaining liver vitamin A reserves during winter feeding has been noted elsewhere (Wheeler, et al., 1957). The liver carotene levels of animals

on the hay rations (Lots 5 and 6) were also significantly higher, as might be expected, since the carotene content of the high-concentrate rations was very low. It is interesting that liver vitamin A levels in heifers appeared consistently higher than those in steers on the same ration (Lots 2, 4, and 6 are higher than Lots 1, 3, and 5).

TABLE 5. Carotene and Vitamin A Levels in Livers of Steers (Data taken first year on test)

Lot No.	Values per gram of fresh liver tissue	
	β -carotene (milligrams)	Vitamin A (International units)
1	0.67	21.7
2	1.07	40.1
3	0.49	10.5
4	0.76	29.2
5	3.27[a]	76.3[a]
6	3.13[a]	83.4[a]

[a] These values, on the conventional hay-grain ration, were significantly higher than those on any of the high-concentrate rations ($P < 0.01$).

Conclusions

1. High-concentrate rations produced faster-gaining cattle which yielded higher-grading carcasses than did the conventional hay and grain ration.

2. Protein supplementation did not improve rate of gain or feed efficiency of high-concentrate rations composed of steam-rolled barley, ground ear corn, and dried beet pulp, and testing about 10% crude protein, unsupplemented.

3. Stilbestrol implants improved the rate of gain of both steers and heifers but caused a very slight reduction in U.S.D.A. grade of steer carcasses.

4. Heifers and steers were approximately equal in rate of gain.

5. Heifer carcasses graded slightly lower than steers but had a higher estimated yield of trimmed retail cuts.

6. Alfalfa hay, fed in a conventional hay-grain ration, proved to be a satisfactory source of vitamin A activity for cattle, under the conditions of this experiment--resulting in higher liver vitamin A and carotene values than high-concentrate rations supplemented with 750 I.U. vitamin A per pound.

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