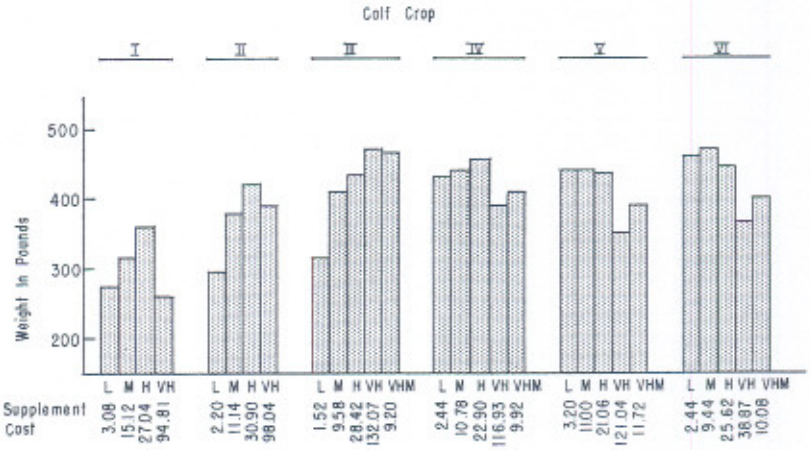

Figure 4. Influence of level of wintering on pounds of calf weaned per cow and supplemental feed cost prior to each calf crop.

damage to milk producing ability occurs early in life and is not corrected by lower levels after the third winter. Percentage calf crop was, however, improved by this treatment.

The data presented for the individual yearly calf crops indicate that rather than select a level of wintering for the life time of the cow, consideration should be given to the life cycle feeding approach in which higher levels are used during growth and development of the female followed by lower levels after the cow has reached maturity since the major influence of the various levels on cow productivity occurs during the first three calf crops.

A Study of Some Factors Affecting Feed Intake and Performance of Finishing Steers

Joe Hughes, S. A. Ewing and L. S. Pope

High concentrate rations have been accepted by many Southwestern feeders as a suitable feeding program for finishing cattle. Associated with feeding a high concentrate ration is a characteristic reduction in total feed intake and in some cases a reduction in calculated caloric intake when compared with conventional rations. Since capacity of the

digestive tract does not appear to be a reasonable explanation for this observed pattern of feed intake, interest is focused on more basic factors which may limit feed and energy intake.

Several theories concerning the regulation of feed intake have been proposed as a result of a series of studies. One of the main factors appears to be energy content or caloric density of the ration. Previous work indicates that the animal possesses mechanisms by which it can regulate energy intake when the fill or rumen load is not the limiting factor on intake. Other factors include bulkiness of the ration, end products of digestion and rate of passage.

A three-year study of some of the factors affecting feed intake of ruminants was initiated at this station in the fall of 1962. To date, five feeding trials have been conducted with steers to study the influence of ration density, bulk, and caloric source on feed intake. Trials 1, 2 and 3 were reported in the 1964 Feeder's Day Report[1], and the results of Trial 4 were reported in the 1965 Feeder's Day Report[2]. Results of the three-year study will be summarized in this report, and results of Trial 5 will be presented and discussed.

Three-Year Study

Milo served as the base grain for all rations used in the five feeding trials. The conventional rations contained 20-30 percent cottonseed hulls, while the high concentrate rations contained 95 percent concentrate with 5 percent alfalfa meal as the only source of roughage. These rations were modified by adding 5 percent stabilized animal tallow in order to study the effects of caloric source. Density and bulk effects were investigated by adding 16-20 percent sand and 13 percent inert polyethylene resin. All rations were fed free choice in self feeders.

The values presented in Tables 1 through 4 are averages of the number of comparisons indicated in the title of each table. Comparisons were drawn from five feeding trials. Estimated net energy values were calculated from published values.[3] Cutability scores are calculated estimates of the percent yield of boneless retail cuts[4].

HIGH CONCENTRATE vs. CONVENTIONAL RATIONS

Six comparisons of conventional and high concentrate rations are summarized in Table 1. Considering the average value, total feed intake was 21 percent greater with the conventional diet; however, daily concentrate intakes were similar for the two rations. Greater estimated net energy intake and higher average daily gain were obtained with the conventional ration. Feed efficiency expressed as total pounds of feed per 100 lbs. of gain favored the high concentrate ration, however, the

[1] Oklahoma Agricultural Exp. Station Misc. Pub. MP-74.
[2] Oklahoma Agricultural Exp. Station Misc. Pub. MP-76.
[3] Calculated from values in Morrison's *Feeds and Feeding*, 22nd Ed., Appendix Table 2.
[4] Calculated by the method of G.E. Murphey, D.K. Hallett, W.E. Tyler and J.C. Pierce. 1960. Estimating Yields of Retail Cuts from Beef Carcasses. J. Animal Sci. 19:1240. (Abstr.)

Table 1. Comparison of High Concentrate and Conventional Rations (Average of 3 comparisons)

	Type of Ration	
	Conventional	High Concentrate
No. of steers	16	16
Daily gain, lbs.	2.43	2.24
Daily feed intake, lbs.	27.87	21.99
Daily concentrate intake, lbs.	21.34	21.99
Est. daily net energy, megacal.	16.98	15.91
Total feed/100 lbs. gain, lbs.	1154	981
Concentrate/100 lbs. gain, lbs.	880	981
Carcass grade	choice—	choice—

amount of concentrates required per 100 pounds gain was 11 percent less when the conventional diet was fed. No important carcass differences were noted.

Data from this comparison indicates that some roughage in the diet may be necessary for maximum performance.

EFFECTS OF FAT ADDITIONS TO HIGH CONCENTRATE RATIONS

Results obtained when 5 percent stabilized animal tallow was added to high concentrate rations are summarized in Table 2. The addition of tallow reduced total feed intake and slightly increased estimated daily net energy intake. Average daily gain and feed efficiency favored the high concentrate ration without added fat. The feed efficiency patterns obtained in this comparison with high concentrate rations are opposed to results of fat additions to conventional rations. Most workers report an improved feed efficiency when 4-5 percent animal tallow is added to conventional finishing rations. Carcass grades and cutability scores were similar for both rations.

The data indicates that estimated daily net energy intake may be slightly increased by the addition of tallow to high concentrate rations; however, average daily gain did not parallel estimated net energy intake. Since rate of gain was not increased and since carcass cutability scores do not suggest important differences in composition it is doubtful if calculated net energy intake is a reliable measure of actual net energy consumption in this case.

EFFECTS OF SAND ADDITIONS TO CONVENTIONAL RATIONS

The results of four comparisons are summarized in Table 3. It appears that steers attempted to compensate for the sand additions by increasing total feed consumption; however, considering the average value, complete compensation for the nutrient dilution was not obtained. Daily concentrate intake and estimated net energy intake were slightly higher for the conventional ration without sand. Feed efficiency and daily gain also tended to favor the ration without sand.

Undoubtedly, sand acted as an energy diluent, and steers attempted to compensate for the dilution by increasing total feed intake. Improved

Table 2. Comparison of High Concentrate Rations With and Without 5 Percent Stabilized Animal Tallow (Average of 4 comparisons).

	Type of Ration	
	High Concentrate	High Concentrate + Tallow
No. of steers	19	20
Daily gain, lbs.	2.49	2.33
Daily Feed intake, lbs.	21.68	20.98
Est. daily net energy intake, megcal.	15.85	16.58
Total feed/100 lbs. gain, lbs.	884	904
Carcass grade	Good+	Choice−
Cutability score, percent	49.37	49.54

Table 3. Influence of Ration Density Increased by Sand Additions. (Average of 4 comparisons).

	Type of Ration	
	Conventional	Conventional + Sand
No. of steers	15	15
Daily gain, lbs.	2.53	2.39
Daily feed intake, lbs.	27.21	31.58
Daily concentrate intake, lbs.	21.05	20.17
Est. daily net energy intake, megcal.	16.51	15.92
Total feed/100 lbs. gain, lbs.	1086	1333
Concentrate/100 lbs. gain, lbs.	836	851
Carcass grade	Good+	Good+

feed efficiency due to physical stimulation of sand on the rumen lining is not evident in this data. In regard to the rations used in this comparison, it appears that density *per se* is not a limiting factor in feed intake of ruminants.

EFFECTS OF INERT BULK ADDITIONS

Data from inert bulk studies are presented in Table 4. Daily feed intake increased when 13 percent inert polyethylene resin was added to a high concentrate ration. Complete compensation for the nutrient dilution was not obtained since daily concentrate intake was higher for the ration without added polyethylene. Both daily gain and feed efficiency (pounds of concentrate per 100 lbs. gain) favored the ration with added inert bulk. The feed efficiency pattern obtained with inert bulk additions was very consistant throughout the three-year study. To illustrate this consistancy, the feed efficiency values for six comparisons are also shown in Table 4. In comparing the average values, added polyethylene improved feed efficiency (pounds of concentrate per 100 lbs. gain) by 13 percent. A possible explanation for this improvement is discussed in another section of this report. Carcass grades and cutability scores were almost identical for both rations.

Table 4. Influence of Inert Bulk Additions to a High Concentrate Ration (Average of Six Comparisons)

	Type of Ration	
	High Concentrate	High Concentrate + Polyethylene
No. of steers	29	29
Daily gain, lbs.	2.48	2.63
Daily feed intake, lbs.	21.03	22.40
Daily concentrate intake, lbs.	21.03	19.48
Calculated daily net energy intake megcal.	16.20	15.07
Feed/100 lbs. gain (including polyethylene)	857	852
Concentrate/100 lbs. gain, lbs.		
6 comparisons		
1	942	718
2	901	796
3	785	729
4	990	768
5	745	718
6	780	720
Average	857	742
Carcass grade	Choice—	Choice—
Cutability score, percent	49.52	49.40

Data from this comparison indicates that improved performance was obtained when a limited amount of bulky material was added to a high concentrate ration. It appears that some bulk may be necessary for the most efficient utilization of concentrates.

Trial 5 Experimental Procedure

The final trial of a three-year study of factors affecting feed intake of finishing steers was initiated in the spring of 1965. Forty yearling Hereford steers were fed a conventional ration for two weeks, after which time 12 hour shrunk weights were taken. The steers were then assigned on a basis of weight to eight groups of five animals each. Groups were then randomly assigned to treatment so as to provide 2 replicate lots for each of four experimental rations. The rations were

B-High concentrate ration (95 percent concentrate)
C-High concentrate plus 13 percent polyethylene fluff as a source of inert bulk.
D-High concentrate with 5 percent stabilized animal fat
E-High concentrate with 5 percent stabilized fat plus 13 percent polyethylene fluff.

Percent composition of the rations is presented in Table 5. These rations were fed free choice in self feeders for 113 days. Steers were kept in paved lots bedded with sand. Water and loose salt were available at all times. Interim weights were taken and total feed consumption for each lot was determined at 21-day intervals. Twelve-hour shrunk weights were taken at the end of the trial, and carcass data were obtained at a commercial packing plant.

Table 5. Composition of Rations Fed in Trial 5.

Ration Ration type	B High Concentrate	C High Concentrate + 13% polyethylene[1]	D High Concentrate + 5% fat	E High Concentrate + 5% fat + 13% polyethylene
Ingredients, percent				
Steam rolled milo	87.00	Same as	80.70	Same as
Cottonseed meal	3.00	B plus	4.00	D plus
Alfalfa meal	5.00	300 lbs.	5.00	300 lbs.
Urea	0.80	Polyethylene	1.10	Polyethylene
Molasses	3.00	Added to	3.00	Added to
Stabilized animal tallow	——	1 ton feed	5.00	1 ton feed
Salt	0.50		0.50	
Calcium carbonate	0.65		0.65	
Vitamin A premix	0.03		0.03	
Trace mineral premix	0.02		0.02	
Calculated net energy[2], megacalorie/lbs.	0.73	0.64	0.79	0.69

[1] The polyethylene fluff used as a source of inert bulk was supplied gratis by E.I. Du Pont de Nemours and Co., Inc., Wilmington, Delaware.
[2] Calculated from Morrison's *Feeds and Feeding*, 22nd. Ed., Appendix Table 2.

Results

A summary of the results appears in Table 6. Values represent an average for the replicate groups on each ration.

FEED INTAKE

Addition of inert bulk to high concentrate rations with or without added fat resulted in increased total feed intake. However, complete compensation for the bulk additions was not obtained since the quantity of nutrient intake by steers on rations C and E did not equal the nutrient intake of steers on rations B and D respectively. As a result, higher daily concentrate intakes were obtained with steers consuming rations without added inert bulk.

The addition of tallow to the rations resulted in an increase in total daily feed consumption and a corresponding increase in calculated energy intake. The added energy intake was apparently not utilized efficiently since feed conversion was depressed by the fat addition.

DAILY GAIN

The average daily gain obtained with the high concentrate ration (B) was exceptionally good. The depression in gain observed on the high concentrate ration plus fat (D) cannot be explained since no digestive disturbances were noted. The average daily gains for the two rations containing inert bulk (C&E) were essentially the same. Similarity of gains by steers consuming rations containing bulk was also noted in Trial 4.

Table 6. Summary of Results of Trial 5.

Ration Type of Ration	B High Concentrate	C High Concentrate + 13% polyethylene	D High Concentrate + 5% Fat	E High Concentrate + 5% Fat + 13% polyethylene
No. of steers	9[1]	10	10	10
Initial wt., lbs.	683	684	670	679
Final wt., lbs.	996	980	959	980
Ave. daily gain, lbs. (113 da.)	2.77	2.63	2.56	2.66
Total daily feed intake, lbs.	21.11	21.74	22.56	22.90
Daily concentrate intake, lbs.	21.11	18 92	22.56	19.92
Estimated daily net energy intake, megacalories	15.45	13.85	17.82	15.74
Total feed/100 lbs. gain, lbs.	763	826	880	861
Concentrate/100 lbs. gain, lbs.	763	719	880	749
Carcass data[2]:				
Ave. carcass wt., lbs.	618	598	596	596
Dressing percent	61.9	60.9	62.0	60.8
Rib eye area, sq. in./cwt. carcass	1.78	1.88	1.88	1.80
Fat cover, in./cwt. carcass	0.106	0.106	0.106	0.104
Cutability score percent	49.5	50.0	49.9	49.6
Carcass grade	High Good	Low Choice	Low Choice	High Good

[1] One steer was removed due to weight loss and chronic stiffness.
[2] Appreciation is extended to Maurer-Neurer, Arkansas City, Kansas, for cooperation in obtaining carcass data.

FEED EFFICIENCY

Most published data indicates that approximately 7-8 percent improvement in feed efficiency can be expected when 5 percent fat is added to conventional rations. The depression in feed efficiency obtained with rations containing fat (D&E) is not in agreement with results of Trial 4.

Addition of inert bulk greatly improved utilization of the concentrate portion of the rations. Improvements in feed efficiencies between rations B and C and between rations D and E were 6 and 14 percent respectively.

The specific action of bulk *per se* is not clear. Bulk may aid in maintaining a normal condition within the rumen and thus facilitate absorption of volatile fatty acids (VFA). When natural roughages such as cottonseed hulls and alfalfa hay are added to concentrate diets, the concentration of acetic acid in relation to the concentration of propionic acid increases in rumen fluid. Results of VFA analyses of rumen fluid samples from steers in this trial indicate an increase in the molar percent of propionic acid in steers consuming rations containing polyethylene. Since propionic acid is more efficiently utilized for body gain than acetic acid, this may be a partial explanation for improved feed efficiency with rations containing polyethylene. On the other hand, the polyethylene resin used is relatively inert, and the mode of action of the material is thus difficult to explain. Further studies are needed to elucidate the possible effects of inert bulk.

Summary — Trial 5

The effects of fat additions to high concentrate rations were studied. The influence of bulk *per se* was evaluated by using polyethylene fluff as an inert bulk.

The addition of fat to a high concentrate ration increased daily feed and estimated net energy intake. Average daily gain favored the high concentrate ration without fat; however, gain did not necessarily parallel estimated net energy intake. The addition of inert bulk to high concentrate rations resulted in improved utilization of the concentrate portion of the diet.

Three Year Study

The effects of ration density, caloric source and bulk on feed intake of ruminants were investigated. Conventional and high concentrate rations were modified by sand, tallow and inert bulk additions.

Both feed and energy intakes were reduced when a high concentrate ration was compared with a conventional ration. Data indicates that some roughage may be necessary for maximum performance.

Tallow additions to high concentrate rations reduced total feed intake and slightly increased estimated net energy intake. The addition of sand to conventional rations resulted in increased total feed consumption. Intake of nutrient material approached that of a similar ration without sand.

An increase in daily feed consumption was noticed when polyethylene resin (inert bulk) was added to high concentrate rations. Daily gain and feed efficiency favored rations with added polyethylene. It appears that limited bulk may be important in the most efficient utilization of the concentrate portion of rations used in this study. Cost of the inert bulk material prohibits commercial use at the levels reported.

Weight Loss Patterns of Beef Cows at Calving

S. A. Ewing, Larry Smithson, Dwight Stephens and Derald McNutt

It is becoming common practice to make feeding program recommendations for wintering beef cows on the basis of weight change patterns rather than a given quantity of feed. This approach has the advantage of making research results concerning the relationship between level of feeding and productivity, applicable to a wide variety of conditions. It is then the responsibility of the producer to evaluate his feeding or supplementation program under a particular set of conditions.