Influence of Caloric Source and Bulk on Feed Intake and Performance of Finishing Steers

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Southwestern feeders are continuing to show interest in high concentrate rations for finishing cattle. Involved in this interest are such things as relative cost of energy from roughages and concentrates and problems in preparing, storage, and handling of roughages.

Tests at this station have indicated that feed intake of high concentrate rations is considerably below that noted for rations containing 20 to 30 percent cottonseed hulls. In some cases calculated caloric intake has also been less for the high concentrate rations. Tests at other stations have shown similar results with respect to total feed intake. This work indicates that the animal possesses some mechanism which regulates energy consumption to very nearly the same level when rations ranging from 70 to 95 percent concentrate are fed.

There have been speculations that ration weight per unit of volume or density may be a limiting factor in consumption of high concentrate rations, however, previous work published from this station (MP 70, 1964) suggests that this is not a problem in that rations of varying density have been consumed in amounts to provide approximately equal energy intakes. The question then arises as to how energy intake might be improved when high concentrate rations are fed. To date there has been meager evidence that the mechanism controlling intake may be less sensitive to calories from fat than from carbohydrate. Further, the physical influence of bulk **per se** is of interest in studying rations for ruminants since for many years roughage or bulk has been considered important in maintaining normal rumen function.

The study reported here deals with the addition of fat to conventional and high concentrate rations as an alternative caloric source. Also reported is the influence of inert bulk when added to a high concentrate ration to provide an energy content per pound of ration comparable to that for a conventional finishing ration.

Experimental Procedure

Fifty yearling Hereford steers averaging approximately 700 lbs. were randomly allotted to ten pens of five steers each to provide replicate lots for five experimental treatments. The composition of the experimental rations is shown in Table 1. The rations were as follows:

A — Basal ration containing 20 percent hulls (75 percent concentrate)
B — High concentrate ration (95 percent concentrate)
C — Basal ration with 5 percent stabilized fat.
D — High concentrate ration with 5 percent stabilized fat
E — High concentrate ration with 5 percent fat plus 13 percent polyethylene fluff as a source of inert bulk.

Table 1. Composite of Experimental Rations

Ration Ration Type	A Conventional	B High Conc.	C Conventional +5% fat	D High Conc. + 5% fat	E High Concentrate + 5% fat + 13% polyethylene fluff[1]
Ingredients %:					
Steam rolled milo	62.15	84.55	56.95	79.55	Same as Ration D with 300 lbs. polyethylene fluff added to give calculated energy content per pound similar to Ration C.
Cottonseed meal	8.00	5.00	8.00	5.00	
Alfalfa meal	5.00	5.00	5.00	5.00	
Molasses	3.00	3.00	3.00	3.00	
Urea	1.00	1.50	1.20	1.50	
Stabilized animal tallow	----	----	5.00	5.00	
Cottonseed hulls	20.00	----	20.00	----	
Salt	.50	.50	.50	.50	
Limestone	.30	.40	.30	.40	
Vit. A premix	.03	.03	.03	.03	
Trace mineral premix	.02	.02	.02	.02	
Calculated Net Energy[2] (Megacalorie/lb.)	.630	.726	.690	.788	.685

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

The cattle were placed initially on Ration A diluted with approximately 30 percent additional cottonseed hulls in self feeders. The hull content was then reduced gradually during the first week. Following this the steers were placed on their respective experimental rations by blending these with Ration A which was then removed gradually during the second week, thus leaving the animals on the various treatments designated for the balance of the experimental period. All rations were self-fed throughout the total period. Initial, final and 28 day interim weights were taken after a 12 hour shrink period without feed and water.

Rumen fluid samples were collected periodically for determination of ratios of volatile fatty acids. Rectal temperatures were also determined at times as a measure of heat stress.

The cattle were slaughtered at a commercial packing plant and the carcass data collected was used to calculate the cutability estimate for the carcasses produced.

Results

A summary of results appears in Table 2. The summary values for each treatment represent an average for the replicate lots on each ration.

Daily Gain

The rate of gain was strikingly similar for all rations containing bulk whether the source was cottonseed hulls or inert bulk fed as poly-

Table 2. Summary of Results

Lot No. Ration Type of Ration	1 A Conventional	2 B High Concentrate	3 C Conventional + 5% fat	4 D High Concentrate + 5% Fat	5 E High Concentrate + 5% Fat with 15% polyethylene fluff
No. of steers	10	10	10	10	9[1]
Initial wt., lbs.	704	700	712	703	686
Final wt., lbs.	1043	992	1054	980	1028
132 day gain, lbs.	339	292	342	277	342
Daily gain, lbs.	2.57	2.21	2.59	2.10	2.59
Total daily feed intake, lbs.	27.4	22.3	25.7	19.4	22.5
Daily concentrate intake, lbs.	22.9	22.3	20.5	19.4	19.6
Daily net energy intake, megacalories	17.3	16.2	17.7	15.3	15.4
Total feed/100 lb. gain, lb.	1070	1005	990	922	871
Concentrate/100 lb. gain, lbs.	856	1005	792	922	758
Cost of gain, $/cwt.[2]	21.29	2241	22.08	22.40	[4]
Carcass observations:[3]					
Dressing %	61.0	61.1	61.2	61.4	60.6
Rib eye area, sq. in.	10.63	11.06	11.44	10.97	10.48
Ave. carcass wt.	636.2	606.1	645.0	601.7	622.8
Rib eye area per 100 lbs. carcass wt., sq. in.	1.67	1.82	1.77	1.82	1.68
Fat cover, in.	.59	.50	.59	.57	.57
Kidney knob wt., %	2.80	2.75	3.30	2.80	2.44
Cutability score, %	48.59	49.72	48.88	49.28	48.77
Carcass grade	Low Choice	Low Choice	Low Choice	Low Choice	Low Choice

[1] One steer died due to fibrous and abscessed kidney.

[2] Feed prices were as follows: milo $2.05/cwt, cottonseed meal $80/T, dehydrated alfalfa meal $40/T, molasses $30/T, urea $120/T, cottonseed hulls $15/T, salt $20/T, limestone $20/T and vitamin A premix $1.00/lb.

[3] Appreciation is extended to Wilson Packing Company, Oklahoma City and Mr. Raymond Fowler, Federal Grading Service, Oklahoma City for cooperation in obtaining carcass data.

[4] The cost per pound of gain for this lot, excluding the cost of the polyethylene addition was $18.42/100 lbs. The cost of the inert bulk used to gain information on the influence of bulk *per se* prohibits commercial use of it at the levels used in these studies.

ethylene fluff. The rate of gain produced by the high concentrate rations was approximately .4 lb. daily below that noted for steers on the bulk containing rations. The addition of 5 percent fat to either the conventional or high concentrate rations had little influence on rate of gain.

Feed and Energy Intake

The characteristic reduction in total feed intake was noted for the high concentrate rations as compared with rations containing 20 percent cottonseed hulls. The addition of 5 percent stabilized animal tallow depressed total feed intake when added to either the conventional or high concentrate rations with the greatest depression occurring when the addition was made to the high concentrate ration. The addition of inert bulk to the high concentrate ration (E) containing fat, increased total feed intake as compared to the same ration (D) without the bulk addition. The net result was complete compensation for the bulk addition in that essentially the same quantity of nutrient containing portion was consumed daily by steers on these two rations. The addition of inert bulk (E) to provide a similar calculated energy content per pound to that of the conventional fat containing ration (C) did not, however, result in equal intake of nutritive containing portion from these two rations.

The results with respect to daily concentrate intake for the various rations indicate that the conventional ration (A) containing 20 percent cottonseed hulls was consumed in an amount to provide almost identical concentrate intake noted for the high concentrate ration (B). The same trend was noted in comparing concentrate intake of rations C and D which were respectively conventional and high concentrate rations containing 5 percent fat additions. The addition of fat reduced daily concentrate intake in both types of rations, however, the greater reduction occurred in the case of the high concentrate ration.

In all cases it appears that steers will compensate for bulk additions to attain very similar levels of daily concentrate intake. The daily intake of calculated net energy from the total ration indicates greater energy intake for the conventional rations (A & C), however, these values may be misleading due to the inability to assess the proper useful energy value to all the feeds involved. Daily gains tend to follow the calculated net energy values closely in all cases except for ration E which contained the inert bulk. It is apparent in this case that the calculated value for net energy greatly under estimated the actual value of the ration since rate of gain was comparable to that noted for the conventional (bulk containing) rations A and C.

Since the addition of fat increased neither the calculated net energy intake nor the rate of gain produced, it does not appear that the mechanism controlling feed and energy intake is less sensitive to fat than carbohydrate.

Feed Efficiency

Feed efficiency tended to be higher for the high concentrate rations which has been characteristic of several studies of this type. The addition of fat reduced feed required per 100 lbs. of gain by 80 pounds (7 percent) when added to the conventional rations and by 83 (8 percent) pounds when the addition was made to the high concentrate ration. The improvement in efficiency resulting from fat additions is rather consistent with values from other work and may serve as a guide in evaluating whether fat may be an economical addition to rations as a replacement for milo.

The influence of bulk on the utilization of the concentrate portion of the ration is interesting. The concentrate required per 100 lbs. of gain also indicates the more efficient utilization of the fat containing rations. A most interesting comparison, however, is that between rations D and E. The addition of inert bulk greatly enhanced the utilization of the concentrate portion of the feed. Then a comparison between rations C and E indicates that some of the energy from the concentrate portion of the ration was required to utilize the cottonseed hulls which in reality points toward a negative net energy value for the hull additions.

The difference in concentrate efficiency of rations A and C may be explained by the fat addition to ration C. These results indicate that some bulk may be important for the most efficient use of concentrates and that even undigestible bulk may serve that purpose.

The explanation for the influence of bulk **per se** is not clear. Speculation may center around its influence on the rumen epithelium to maintain a more normal condition and function or on its influence on rate of passage of materials through the digestive tract. Rate of passage may be particularly important in milo utilization in high concentrate rations if the hardness of the grain particle or nature of the starch requires a longer time for efficient digestion than is characteristic of other grains. Ratios of volatile fatty acid production will be reported later since analyses are not complete at this time. The results with the inert bulk seem to point to the need of adding a bulky material that will not alter the level of propionic acid relative to acetic acid typically produced by high concentrate rations and yet exert the influence of inert bulk observed in this study.

The fact remains, however, that feed cost per pound of gain based on feed prices in the summer of 1964 did not differ widely among rations. These results are, of course, highly dependent on the relative cost of cottonseed hulls and the concentrate portion of the rations. It should be noted that the polyethylene fluff material used in these studies was used as a source of undigestible bulk for the purpose of studying the influence of bulk **per se**. Due to the high cost of the material, it is not a recommended ration addition for commercial purposes. It should be noted further that additional work is needed to verify the results noted in this trial as being due to the inert bulk addition.

No important differences were observed in rectal temperature of steers on the various rations, however, all steers were under rather severe heat stress as indicated by rectal temperatures as high as 105°F.

Summary

The influence of fat additions as an alternative energy source in conventional and high concentrate rations was studied. Also the influence of bulk **per se** added to a high concentrate ration was evaluated by using polyethylene fluff as a source of inert bulk.

Rate of gain was superior for all rations containing bulk whether in the form of cottonseed hulls or polyethylene.

Feed efficiency favored the high concentrate rations and fat additions to either high concentrate or conventional rations improved feed efficiency by 8 and 7 percent respectively. The addition of inert bulk to a high concentrate ration resulted in a marked improvement in efficiency with which the concentrate portion of the ration was utilized. Some possible reasons for this improvement are discussed, however, these results are considered preliminary at this time. The cost of the source of inert bulk used prohibits the commercial use of the material at the level reported.

The feed cost per pound of gain favored the conventional ration but these results are subject to relative prices of cottonseed hulls and concentrate ingredients in the ration. Fat additions did not reduce cost of gain at the prevailing price at the time the test was conducted.

Cutability score of carcasses tended to favor the high concentrate rations. Average carcass grade was the same for all treatments used in the study.

Genetic Relationships Between Growth and Carcass Traits

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Numerous studies have shown that measures of growth rate in beef cattle are highly heritable. Thus, selection of breeding stock with superior gaining ability will result in genetic improvement in growth rate. When devising breeding programs which include selection for growth rate, it is important to consider the effect of genetic change resulting from this selection on other traits of economic importance.