# BEEF CATTLE FEEDING INVESTIGATIONS

- Optimum Level of Protein Supplement
- Solvent versus Hydraulic Cottonseed Meal
- Effect of Adding Carotene to Fattening Rations

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# The Story In Brief

Many farmers and ranchers in Oklahoma are attempting to increase their gross return from beef cattle by practicing a dry lot fattening program. The method generally followed is to retain at least a part of the calves after weaning and fatten them to slaughter finish by feeding grain and roughage produced on the farm.

Profits from feeding cattle fluctuate widely from year to year, but for those who produce both grain and roughage the only major "out of pocket" cost is for protein supplement. Also, more profit is usually realized from grain and roughage when marketed through fat cattle than when sold as "cash crops". In addition, valuable plant nutrients are returned to the soil.

This bulletin summarizes the results of a five-year study to determine:

The best level of protein supplement in fattening rations for steer calves.

The effect of gradually reducing the level of protein supplement during the fattening period.

The value of new "pre-press solvent extracted" cottonseed meal.

The effect of adding a crude carotene concentrate to fattening rations when only a small amount of legume hay is fed.

Results show that:

Steer calves fed 1.5 pounds of cottonseed cake daily returned greater profits than those fed at rates of 1.0 and 0.5 pound.

Steers fed the same amount of protein supplement throughout the feeding period made better gains than those receiving reduced amounts of supplement as the feeding period progressed.

New solvent-processed cottonseed meal had slightly lower feeding value than hydraulic meal.

Neither gain nor feed efficiency was improved by adding a crude carotene concentrate to the protein supplement.

# BEEF CATTLE FEEDING INVESTIGATIONS

## Optimum Level of Protein Supplement
## Solvent versus Hydraulic Cottonseed Meal
## Effect of Adding Carotene to Fattening Rations

*By L. S. Pope, R. D. Humphrey, A. E. Darlow, V. G. Heller, O. B. Ross, and R. A. Long**

This bulletin reports the results of feeding trials with beef cattle which were designed to answer four questions as follows:

- What is the best level of protein supplement (cottonseed cake) in fattening rations for steer calves?
- What is the effect of gradually reducing the level of cottonseed cake during the fattening period?
- What is the value of new "pre-press solvent extracted" cottonseed meal relative to the hydraulic processed cottonseed meal commonly used to supplement fattening rations?
- What value is obtained from a crude carotene concentrate when added to fattening rations containing only a small amount of legume hay?

These problems were studied in response to questions from cattlemen in Oklahoma who are showing increased interest in fattening cattle in dry lot. Many small ranchers and farmers are seeking ways of increasing their gross return from beef cattle by means of a short feeding period. Such feeding periods are usually of shorter duration than those practiced by cornbelt feeders, and this, together with a difference in feeds used, poses numerous problems for cattle feeders in Oklahoma which cannot be answered from existing experimental evidence.

Fattening cattle in dry lot is always costly. Therefore, anything that will increase daily gains, improve the efficiency of feed utilization,

* Respectively: Associate Animal Husbandman; Assistant Superintendent of Ft. Reno Exp. Sta., El Reno; Formerly Head of Animal Husbandry Dept., now Dean of Agriculture and Vice-President of Oklahoma A. & M. College; Agricultural Chemistry Research; Former Animal Husbandman; and Former Animal Husbandman.

or raise the market grade of the cattle is vitally important to the feeder. Rations for full-feeding must be properly balanced with respect to protein, carbohydrates, vitamins, and minerals for best results. Yet, on a pound-for-pound basis, protein supplements are normally the most expensive of any of the feeds used. In addition, they are frequently the only "out-of-pocket" cost of cattle feeding—the grain and roughage having been produced on the farm. With increased livestock numbers, it is likely that protein supplements will remain in short supply, and therefore high in price, for some time. It will be most profitable then, to feed fattening cattle only the minimum amount necessary for best gains, efficient feed conversion, and proper finish. This study attempts to determine the optimum amount needed in standard fattening rations for steer calves.

Recently, cottonseed processors have developed a new method of "pre-press solvent extraction" which permits them to remove nearly all of the oil from the whole seed. In this study, the feeding value of this new solvent meal was compared to that of hydraulic meal, which is much higher in fat content.

The amount of roughage in fattening rations is usually limited in order to obtain maximum grain intake. Most grains and protein supplements are poor sources of vitamin A. Lack of a legume roughage in the ration may lead to a vitamin A deficiency in cattle fattening in dry lot over a long period of time. In this study, the value of adding a crude carotene concentrate to fattening rations for steer calves was investigated.

## PROCEDURE

The feeding trials reported herein were conducted at the experimental feeding shed west of Stillwater during the period 1948-53. One hundred and ninety-six choice, weanling, Hereford steer calves were used in these tests. The calves were approximately seven and a-half months old at the start of the test. They were given about three weeks, from the time of arrival at the shed until the experiment started, to recover from the effects of weaning and to become accustomed to the change in feed.

An average of three consecutive daily weights, taken at the beginning and end of the experimental period, were used as the base weights. Additional weights were obtained at 28-day intervals. The steers were confined to small concrete-paved pens with access to an open shed throughout the experiment.

The rations were hand-fed twice daily in open bunks. Half of the daily allowance of grain, protein supplement, and silage was fed each time. The limited amount of alfalfa hay was fed in a separate bunk at the time of the morning feed. Salt and a mineral mixture composed of equal parts salt, steamed bone meal, and ground limestone were available to the steers at all times.

The steers were sprayed with rotenone three times each year (November, December, and January) for the control of grubs. They were sprayed with BHC once each year (about mid-winter) for the control of lice.

The length of the feeding period varied from 163 to 180 days. At the completion of each test, the steers were sold on the Oklahoma City market. With the exception of four trials, carcass grades were obtained.

## RESULTS AND DISCUSSION

### Optimum Level of Protein Supplement

Four trials were conducted to determine the most desirable level to feed cottonseed cake (1.5, 1.0, or 0.5 pounds per head daily) in fattening rations for steer calves. In addition to cottonseed cake, calves in each lot received the following basal ration:

| | |
|---|---|
| Ground shelled corn | Full-fed |
| Alfalfa hay | 1.0 pound per head daily |
| Sorghum silage | Limited amounts |
| 1-1-1 Mineral mixture and salt | Free choice |

The average results obtained are summarized in Table I. The chemical composition of the feeds used and their costs are shown in Appendix Table I.

Average daily gains significantly favored steers fed the 1.5 pounds of cottonseed cake daily. These cattle required less corn and roughage per 100 pounds of gain. The feed cost for each 100 pounds of gain was slightly less than for steers fed the 1.0 pound level. Another advantage of the higher level of protein supplement was in the selling price. The selling price per hundred weight for steers fed 1.5 pounds of supplement was $ .33 higher than for those fed 1.0 pound, and $ .68 more than for those fed 0.5 pound. The returns per steer varied accordingly. Greater daily gains, improved feed efficiency, and higher selling price made the profits from the feeding operation proportional to the level of cottonseed cake fed.

**Table I.—Optimum Level of Cottonseed Cake in Fattening Rations for Steer Calves (Average of four trials, 1948-52, 173 days on test).**

| | Cottonseed cake fed per steer daily (pounds) | | |
|---|---|---|---|
| | 1.5 | 1.0 | 0.5 |
| Total number of steers | 38[1] | 40 | 40 |
| Average weights (lbs.) | | | |
| Initial | 488 | 487 | 488 |
| Final | 864 | 847 | 830 |
| Total gain | 376 | 360 | 342 |
| Average daily gain | 2.17 | 2.08 | 1.98 |
| Average daily rations (lbs.) | | | |
| Ground shelled corn | 11.09 | 11.35 | 11.12 |
| Cottonseed cake | 1.50 | 1.00 | 0.50 |
| Alfalfa hay | 1.00 | 1.00 | 1.00 |
| Sorghum silage | 6.88 | 6.89 | 6.84 |
| Salt | .04 | .04 | .04 |
| 1-1-1 Mineral mixture[2] | .04 | .04 | .04 |
| Feed required per cwt. gain (lbs.) | | | |
| Ground shelled corn | 510 | 545 | 563 |
| Cottonseed cake | 69 | 48 | 25 |
| Alfalfa hay | 46 | 48 | 51 |
| Sorghum silage | 316 | 331 | 346 |
| Feed cost per cwt. gain (dollars) | 19.71 | 20.03 | 19.74 |
| Financial results (dollars) | | | |
| Selling price per cwt. | 31.06 | 30.73 | 30.38 |
| Total value per steer (3% shrink) | 260.28 | 252.60 | 244.56 |
| Initial cost per steer | 154.42 | 154.03 | 154.42 |
| Feed cost per steer | 74.12 | 72.12 | 67.50 |
| Total cost per steer | 228.54 | 226.15 | 221.92 |
| Return per steer | 31.74 | 26.45 | 22.64 |
| Ave. U.S. carcass grade[3] | Top choice | Ave. choice | Ave. choice |

[1] One steer removed from the 1949-50 trial and one from the 1951-52 trial. Data are not included for these steers.

[2] Mineral mixture consisted of equal parts of salt, steamed bone meal, and ground limestone.

[3] Carcass data obtained for the 1950-51 and 1951-52 trials only.

In previous research at this Station (1),* calves fed 2.5 and 3.5 pounds of cottonseed cake per head daily failed to show increased gain or more efficient use of feed than calves fed 1.5 pounds daily. Thus, for weanling calves receiving this type of ration, a level of approximately 1.5 pounds per head daily appears more profitable. Obviously, if the roughage fed is lower in protein than that used in these trials (cottonseed hulls for example) or the grain is higher in protein than corn (such as milo, oats, or barley), an adjustment in the amount of protein supplement should be made.

* Numerals in parentheses refer to Literature Cited on page 20.

Many cattle feeders tend to over-conserve on protein supplement. This is understandable due to its high cost relative to grain. However, fully 75 percent of the total feed cost in this study was in the grain; while less than 15 percent was in the protein supplement. Thus, the efficiency with which a fattening steer utilizes grain largely determines the profit or loss from the feeding operation. Lack of protein causes inefficient use of grain and roughage and results in a poorly-fleshed group of cattle at the end of the feeding period.

As these trials progressed, it became apparent that the steers fed the two higher levels of cottonseed cake exhibited much keener appetites and consumed more grain during the early part of the feeding trial than those fed 0.5 pound per head daily. Also, they were easier to keep on full-feed. Hence, they tended to make faster gains early in the period, and largely maintained this advantage as the trial progressed. When the gains of the steers by 28-day periods were examined (See Table II), it was found that the higher levels of protein supplement exerted their greatest beneficial effect during the first half of the feeding period. These data are shown graphically in Figure 1.

During the last half of each feeding trial, there was little difference in average daily gain among the lots. In fact, calves fed the 1.0 and 0.5 pound levels gained equally as well as those fed 1.5 pounds per head daily. It may have been that the advancing age and greater feed con-

**Table II.—Average Daily Gains by 28-day Periods of Fattening Steer Calves Fed Different Levels of Cottonseed Cake. (Four-year average, 1948-52)**

| | Cottonseed cake fed per steer daily (pounds) | | |
|---|---|---|---|
| | 1.5 | 1.0 | 0.5 |
| Periods: | *Average Daily Gains (pounds)* | | |
| 1-28 days | 2.41 | 2.13 | 1.97 |
| 29-56 days | 1.92 | 1.83 | 1.56 |
| 57-84 days | 2.32 | 1.97 | 2.04 |
| 85-112 days | 2.19 | 2.16 | 2.05 |
| 113-140 days | 1.97 | 2.42 | 2.23 |
| 140-173 days | 2.02 | 1.99 | 2.04 |
| Entire period | 2.17 | 2.08 | 1.98 |

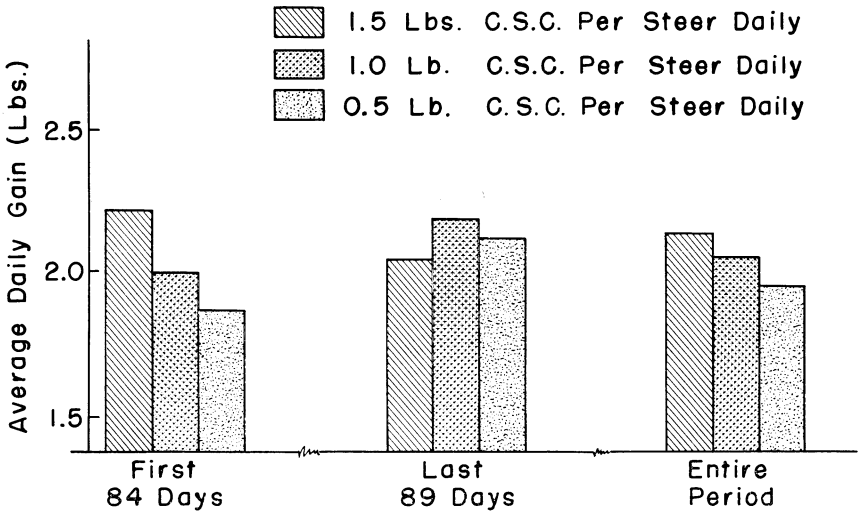


**Figure 1.—Average daily gains by various periods for fattening steer calves fed different levels of cottonseed cake (four-year average, 1948-52).**

sumption toward the end of the trial made the need for protein supplement less critical, thus accounting for nearly equal gains.

From this four-year test, it appears that the greatest beneficial effect of the higher levels of protein supplement was obtained early in the trial. It is common practice to start calves on rather small amounts of protein supplement, and to increase the allowance gradually with advancing age. This study indicates that larger amounts are needed early in the fattening period. In later tests, it was not possible to demonstrate an advantage for gradually reducing the level of protein supplement as the trial progressed.

The average results obtained from four feeding trials, while significantly in favor of the higher level of protein supplement, was not entirely consistent from year to year. On further examination of the data, it appeared that considerable variation existed in the initial weight, age, and development of the calves used from year to year. When the calves were divided into heavy and light groups on the basis of initial weight, a further influence of size and development on the optimum level of protein supplement became apparent.

The heavy group of calves weighed an average of 522 pounds. The light calves averaged 456 pounds. The average daily gains for each

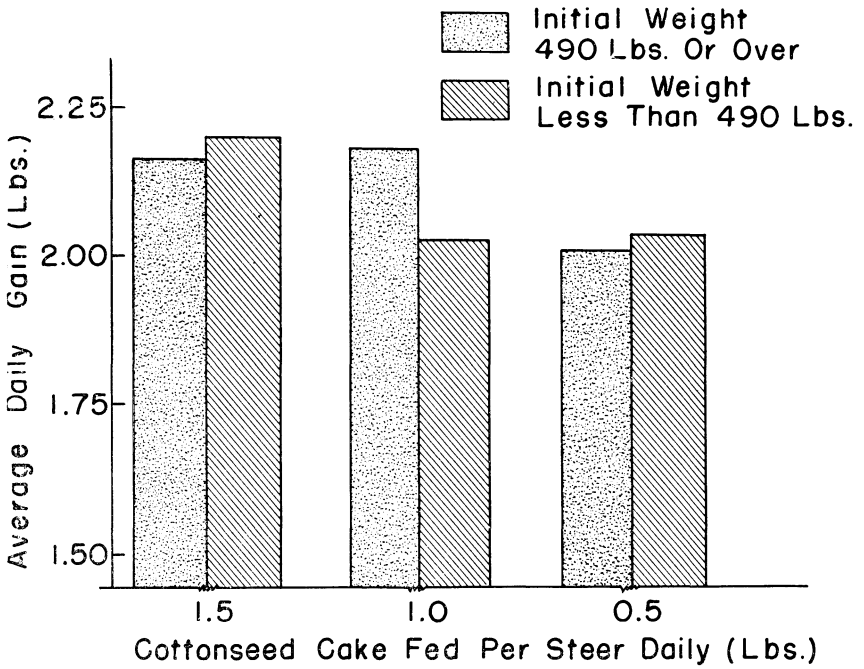


**Figure 2.—Average daily gains of fattening steer calves as influenced by initial weight and level of cottonseed cake fed (four-year average, 1948-52).**

group according to the level of protein supplement fed are shown in Table III and Figure 2.

Using average daily gain as the criterion, it appears that the 1.5 pound level was adequate for both the heavy and light calves in these trials. The 1.0 pound level was adequate for the heavy calves, but was not sufficient for the lighter calves. The 0.5 pound level was too low for best gains with either the light or heavy calves. Assuming that the initial weight of the calf is a fair indication of age and development, the optimum level of protein supplement may vary accordingly. The protein level is more critical for the younger, lighter calves.

Under practical feedlot conditions, it is seldom that a drove of calves will be as uniform as either group used in this comparison. Rather, there will normally be a considerable variation in age and development. Therefore, for "insurance" reasons, it seems logical to recommend the 1.5 pound level when rations of the type fed here are used, in order to meet the needs of the smaller calves in the drove.

**Table III.—Average Daily Gains of Fattening Steer Calves As Influenced By Initial Weight and Level of Cottonseed Cake Fed. (Four-year average, 1948-52)**

| Levels of cottonseed cake fed (pounds) | Initial weight 490 lbs. or more | | Initial weight less than 490 lbs. | |
|---|---|---|---|---|
| | Average initial wt. | Average daily gain | Average initial wt. | Average daily gain |
| 1.5 | 521 | 2.14 | 455 | 2.17 |
| 1.0 | 522 | 2.16 | 456 | 1.99 |
| 0.5 | 521 | 1.98 | 456 | 1.99 |

### Varying the Amount of Protein Supplement Fed

The results obtained in the previous test indicated that the higher levels of protein supplement increased gains early in the feeding period, but were of little benefit during the last half of the trial. It seemed possible, therefore, to attempt to conserve on protein supplement and decrease feed costs by gradually reducing the level of cottonseed meal as the feeding trial progressed.

Two feeding trials were conducted in which the level of protein supplement was reduced in stepwise fashion, as compared to feeding the same average amount throughout the trial. In the first trial, Lot 1 steers were fed the same type of basal ration as shown previously, with 1.5 pounds of cottonseed meal per head daily throughout the trial. Lot 2 steers received 1.5 pounds of cottonseed meal daily for the first 60 days, 1.0 pound for the second 60 days, and 0.5 pounds for the remainder of the 172-day trial. Lot 3 received 1.0 pound of meal throughout the trial, or approximately the same average intake as Lot 2. The results are summarized in Table IV.

In this test, no benefit was obtained by reducing the protein supplement as the feeding period progressed. Steers in Lot 2 gained less than those in Lot 3, and both lots gained less than steers fed 1.5 pounds throughout. Market value and feed costs per hundred pounds of gain varied accordingly.

In the second trial, Lot 1 steers were fed 1.5 pounds of cottonseed meal throughout. Lot 2 received 2.0 pounds for the first 60 days, 1.5 pounds for the second 60 days, and 1.0 pound for the remainder of the trial, or an average of about 1.5 pounds daily. The results are shown in Table IV. Again, no advantage was gained from the practice of gradually

reducing the amount of protein supplement fed during the trial. Gains of Lot 2 steers during the first 60 days of the trial were no greater than those of Lot 1, and feed costs per hundredweight gain were higher.

In general, these results are in agreement with research at the Ohio station, where Gerlaugh (2) was unable to show an advantage for reducing the level of protein supplement in the ration during the fattening period. It is possible that protein supplements such as cottonseed meal exert

**Table IV.—Effect of Gradually Reducing the Level of Cottonseed Cake in Fattening Rations for Steer Calves.**

| | Trial 1 (172 days) | | | Trial 2 (163 days) | |
|---|---|---|---|---|---|
| | Lot 1 1.5 lbs. Through-out | Lot 2 1.5 lbs. Reduced to 0.5 lb.[1] | Lot 3 1.0 lb.[1] Through-out | Lot 1 1.5 lbs. Through-out | Lot 2 2.0 lbs. Reduced to 1.0 lb.[1] |
| Number of steers per lot | 9[2] | 10 | 10 | 10 | 9[2] |
| Average weights (lbs.) | | | | | |
| Initial | 464 | 460 | 460 | 472 | 467 |
| Final | 845 | 802 | 814 | 838 | 825 |
| Total gain | 381 | 342 | 354 | 366 | 358 |
| Average daily gain | 2.22 | 1.99 | 2.06 | 2.24 | 2.20 |
| Average daily ration (lbs.) | | | | | |
| Ground shelled corn | 10.97 | 11.08 | 11.13 | 10.90 | 10.82 |
| Cottonseed meal | 1.50 | 1.05 | 1.00 | 1.50 | 1.55 |
| Alfalfa hay | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Sorghum silage | 7.76 | 7.76 | 7.72 | 7.92 | 7.40 |
| Salt | .02 | .02 | .03 | | |
| 1-1-1 Mineral mixture[3] | .03 | .02 | .04 | .04 | .04 |
| Feed required per cwt. gain (lbs.) | | | | | |
| Ground shelled corn | 495 | 557 | 541 | 485 | 493 |
| Cottonseed meal | 68 | 53 | 49 | 67 | 71 |
| Alfalfa hay | 45 | 50 | 49 | 45 | 46 |
| Sorghum silage | 350 | 390 | 375 | 353 | 337 |
| Feed cost per cwt. gain (dollars) | 21.26 | 22.93 | 22.17 | 21.52 | 21.92 |
| Financial results (dollars) | | | | | |
| Selling price per cwt. | 34.00 | 33.25 | 33.40 | 23.25 | 23.33 |
| Total value per steer (3% shrink) | 278.80 | 258.69 | 263.86 | 189.02 | 186.64 |
| Initial cost per steer | 182.58 | 181.01 | 181.01 | 132.16 | 130.76 |
| Feed cost per steer | 80.90 | 78.61 | 78.61 | 79.06 | 78.70 |
| Total cost per steer | 263.48 | 259.62 | 259.62 | 211.22 | 209.46 |
| Return per steer (dollars) | 15.32 | —0.93 | 4.24 | —22.20 | —22.82 |
| Ave. U. S. carcass grade | Top Ch. | Ave. Ch. | Ave. Ch. | Ave. Ch. | Top Ch. |

[1] Protein supplement fed Lot 2 was reduced as follows: Trial 1, 1.5 lbs. for first 60 days, 1.0 lb. for second 60 days, and 0.5 for remainder of trial; Trial 2, 2.0 lbs. for first 60 days, 1.5 lbs. for next 60 days, and 1.0 lb. for remainder of trial.

[2] One steer removed from each lot and are not included in data.

[3] In Trial 2, a mineral mixture of two parts salt and one part steamed bone meal was fed.

other effects aside from those associated with their protein content alone. The maintenance of appetite may be an important additional value.

In commercial feedlots, it is common practice to reduce the amount of protein supplement during the latter part of the feeding period. However, this practice lacks experimental support at this time. For feeding calves, it seems most logical to recommend that the same level of protein supplement be fed throughout the fattening period, rather than risk reduced gains toward the important finishing phase of the period.

### Solvent versus Hydraulic Cottonseed Meal

Fats or oils are a small, but important, part of feeds. In fattening rations, they have about 2.25 times the energy value of carbohydrates. Even though the amount in the feed may be small, percentagewise, its effect may be considerable.

A new "pre-press solvent" method of extraction is now being adopted by cottonseed crushers whereby nearly all of the oil can be removed from the whole seed in the manufacture of oil meal. An experiment was undertaken to determine if the feeding value of the cottonseed meal so processed is altered by the nearly complete removal of the oil.

Two trials were conducted in which hydraulic-processed cottonseed meal was compared to "pre-press solvent extracted" meal in rations for fattening calves*. In these trials, the same type of basal ration as described previously was fed, and supplemented with equal levels of the two meals. The results obtained are summarized in Table V.

The steers of Lot 1, fed the hydraulic processed cottonseed meal, gained 0.06 pounds per head daily more than those fed the solvent extracted meal (Lot 2). Although this difference is small, it was consistent in both trials and is perhaps a reflection of the difference in energy content of the two meals. The average percentage of oil (ether extract) in the two meals, was 6.8 percent for the hydraulic meal, and 0.63 percent for the solvent product. In order to maintain the solvent-extracted meal at a 41% protein level, which is standard for the feed trade, fibrous by-products which are much lower in net energy content than oil are added to the meal. As shown in Appendix Table I, there is a difference in the crude fiber contents of the two meals.

Although these trials are by no means conclusive, the results obtained, together with those reported by other stations (Marion et. al.,

*The "pre-press solvent extracted" cottonseed meal used in this study was supplied by the National Cottonseed Products Association, Dallas, Texas.

4, 5), indicate that the solvent meal has slightly lower value in supplementing fattening rations. In wintering trials at this station (6,7) and elsewhere, no consistent difference has been demonstrated between the two meals for wintering cattle to make only small gains in weight. However, in the feedlot where maximum gain is desired, a small difference in fat content is likely to be important, as is indicated by the results obtained by Willey and associates (8). The solvent meal used in these trials was rather dry and dusty, although when fed with silage and other ingredients of the ration, no difference in palatability was apparent.

### Effect of Adding a Carotene Concentrate to Fattening Rations*

When only small amounts of legume hay are fed to fattening steers, a deficiency of vitamin A is possible. Many commercial protein supplements are fortified with vitamin A as insurance against a deficiency. An adequate source of carotene in the ration may be particularly important with weanling calves coming into the feedlot from drouth-stricken range.

Three trials were conducted to determine whether the addition of carotene to a fattening ration of the type used in previous studies would improve the performance of steer calves. Steers of Lot 1 received the basal ration supplemented with cottonseed cake. Steers of Lot 2 were fed pelleted cottonseed meal to which a crude carotene concentrate was added to supply approximately 20.5 mg of carotene per steer daily. The alfalfa hay used in these trials was bright and leafy, and number 2 grade yellow corn of the current year's crop was fed. The carotene content of the silage was low and somewhat variable. It was calculated that the basal ration supplied somewhat less than the recommended daily intake of carotene for calves of the age and weight used.

The results are summarized in Table VI. No consistent difference was observed in average daily gains or efficiency of feed utilization between steers of the two lots. Thus, carotene supplied by the feeds in the basal ration, plus vitamin A stores in the bodies of the calves, must have been sufficient for satisfactory gains. These trials were conducted following relatively good pasture seasons, and hence the calves probably had considerable liver and body stores of carotene and vitamin A at the start of the trial. It is generally agreed that adding carotene to the ration is not beneficial as long as body stores are ample to meet the animal's needs.

*The crude carotene concentrate used in this study was supplied by Valley Vitamins, Inc., McAllen, Texas.

**Table V.—Hydraulic vs. Solvent Processed Cottonseed Meal for Fattening Steer Calves. (Average of two trials, 1951-53, 168 days on test).**

| | Lot 1 Hydraulic-processed | Lot 2 Pre-press solvent extracted |
|---|---|---|
| Total number of steers | 19[1] | 19[1] |
| Average weight (lbs.) | | |
| Initial | 468 | 469 |
| Final | 842 | 833 |
| Total gain | 374 | 364 |
| Average daily gain | 2.23 | 2.17 |
| Average daily ration (lbs.) | | |
| Ground shelled corn | 10.94 | 11.08 |
| Cottonseed meal | 1.50 | 1.50 |
| Alfalfa hay | 1.00 | 1.00 |
| Sorghum silage | 7.84 | 7.76 |
| Salt | .03 | .03 |
| 1-1-1 Mineral mixture | .04 | .04 |
| Feed required per cwt. gain (lbs.) | | |
| Ground shelled corn | 491 | 511 |
| Cottonseed meal | 67 | 69 |
| Alfalfa hay | 45 | 46 |
| Sorghum silage | 352 | 358 |
| Feed cost per cwt. gain (dollars) | 21.43 | 22.21 |
| Financial results (dollars) | | |
| Selling price per cwt. | 28.63 | 28.25 |
| Total value per steer (3% shrink) | 233.91 | 228.26 |
| Initial cost per steer | 157.37 | 157.63 |
| Feed cost per steer | 80.14 | 80.85 |
| Total cost per steer | 237.51 | 238.48 |
| Return per steer | —3.60 | —10.22 |
| Ave. U. S. carcass grade | Ave. choice | Ave. choice |

[1] It was necessary to remove one steer in each lot during the first trial. Data on these steers are not included.

The length of these feeding trials was considerably shorter than the feeding period in many commercial feedlots. The amount of carotene supplied by the basal ration might not have been sufficient for longer feeding periods in dry lot. Other stations have reported symptoms of vitamin A deficiency in calves on low-carotene rations within 80 to 140 days (3). Additional data at this Station has indicated that in this type of ration, the need for supplemental carotene is more acute when grain sorghum is fed in place of yellow corn.

In these trials, the additional cost of fortifying the ration with carotene increased feed costs and decreased profits per steer. From a

**Table VI.—Effect of Adding a Crude Carotene Concentrate to the Cottonseed Meal Fed Fattening Steer Calves. (Average of three trials, 1948-51, 174 days on test).**

| | Lot 1 Cottonseed cake | Lot 2 Cottonseed meal pellets + carotene* |
|---|---|---|
| Total number of steers | 29[1] | 30 |
| Average weights (lbs.) | | |
| Initial | 496 | 495 |
| Final | 870 | 868 |
| Total gain | 374 | 373 |
| Average daily gain | 2.15 | 2.14 |
| Average daily ration (lbs.) | | |
| Ground shelled corn | 11.12 | 11.43 |
| Protein supplement | 1.50 | 1.50 |
| Alfalfa hay | 1.00 | 1.00 |
| Sorghum silage | 6.59 | 6.58 |
| Salt | .04 | .04 |
| 1-1-1 Mineral mixture | .04 | .04 |
| Feed required per cwt. gain (lbs.) | | |
| Ground shelled corn | 517 | 533 |
| Protein supplement | 70 | 70 |
| Alfalfa hay | 47 | 47 |
| Sorghum silage | 307 | 307 |
| Feed cost per cwt. gain (dollars) | 19.22 | 20.63 |
| Financial results (dollars) | | |
| Selling price per cwt. | 30.08 | 29.92 |
| Total value per steer (3% shrink) | 253.88 | 251.93 |
| Initial cost per steer | 145.38 | 145.08 |
| Feed cost per steer | 71.89 | 74.77 |
| Total cost per steer | 217.27 | 219.85 |
| Return per steer | 36.61 | 32.08 |
| Av. U. S. carcass grade[2] | Ave. choice | Ave. choice |

* Crude carotene concentrate was added to the cottonseed meal to supply 13.7 mg of carotene per pound of supplement fed.

[1] One steer was removed in the second trial and is not included in these data.

[2] Carcass grades obtained only in the third trial.

practical standpoint, the need for fortifying fattening rations with additional carotene or vitamin A will depend upon: (a) the carotene content of the feeds used in the ration—particularly the amount of legume hay fed, (b) the age of the cattle to some extent—calves having less body stores are more susceptible to a deficiency than older cattle, (c) the length of the feeding period, and (d) the character of the previous grazing season or the probable vitamin A stores of the cattle at the time they enter the feedlot.

## SUMMARY

Cottonseed cake fed at the level of 1.5 pounds per head daily in a fattening ration for steer calves (corn, sorghum silage, and a limited amount of alfalfa hay) resulted in greater daily gains, higher selling price, and larger profits per steer than levels of 1.0 or 0.5 pounds. Feed costs per hundred pounds of gain were not increased by feeding the 1.5 pound level because of greater efficiency of feed utilization.

Steer calves fed 1.5 pounds of cottonseed cake made faster gains early in the feeding period and largely maintained this advantage throughout the trial. Also, analysis of the weight gains of heavy and light calves within each level of cottonseed cake fed revealed that at least 1.5 pounds was needed for the younger, lighter calves, while 1.0 pound was sufficient for the heavier calves. Feeding 0.5 pound of cottonseed cake daily was inadequate for both light and heavy calves in this study.

In two tests, varying the level of protein supplement fed so that calves received more during the early part of the trial and less during the latter part was not superior to feeding the same average amount throughout.

Steer calves fed "pre-press solvent extracted" cottonseed meal in two trials gained slightly less than those fed hydraulic-processed meal. Efficiency of feed utilization also favored the steers fed the hydraulic product. These trials indicate that the solvent processed meal may have slightly lower feeding value than hydraulic meal in fattening rations.

Fortifying the rations of fattening steer calves with a crude carotene concentrate did not improve weight gains or feed efficiency. The yellow corn, alfalfa hay and sorghum silage fed for the 174-day period appeared adequate to meet the dietary needs of the calves in these trials.

## Appendix Table I.—Average Chemical Composition and Cost of Feeds Used in Fattening Trials.[1]

| Feeds by trials | Percent dry matter | Percentage composition of dry matter | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Ash | Crude protein | Ether extract | Crude fiber | N-Free extract | Ca | P | Carotene (mg/lb.) | Cost per ton (dollars) |
| *Level of protein study* | | | | | | | | | | |
| Ground corn | 88.44 | 1.59 | 10.45 | 5.07 | 2.38 | 80.76 | .04 | .31 | | 60.97 |
| Cottonseed cake | 93.02 | 6.65 | 43.14 | 6.95 | 11.52 | 31.00 | .24 | .94 | | 77.75 |
| Alfalfa hay | 91.70 | 9.26 | 16.86 | 2.63 | 34.63 | 36.62 | 1.55 | .21 | | 21.12 |
| Sorghum silage[2] | 32.72 | 7.96 | 5.52 | 3.59 | 26.45 | 56.49 | .36 | .29 | | 5.75 |
| *Varying level of protein study* (Trial I) | | | | | | | | | | |
| Ground corn | 88.61 | 1.64 | 10.12 | 4.40 | 2.06 | 81.78 | .06 | .32 | | 67.83 |
| Cottonseed cake | 93.13 | 7.24 | 43.35 | 8.21 | 11.40 | 26.79 | .27 | 1.05 | | 81.00 |
| Alfalfa hay | 92.36 | 10.32 | 17.81 | 2.41 | 29.89 | 39.56 | 1.32 | .18 | | 25.00 |
| Sorghum silage | 30.00 | 7.10 | 5.67 | 6.40 | 26.47 | 54.37 | 1.17 | .47 | | 6.00 |
| (Trial II) | | | | | | | | | | |
| Ground corn | 86.60 | 1.65 | 9.17 | 4.61 | 1.92 | 82.65 | .07 | .13 | | 64.30 |
| Cottonseed meal | 94.01 | 6.49 | 41.99 | 5.37 | 10.18 | 35.96 | .19 | .76 | | 106.00 |
| Alfalfa hay | 91.06 | 11.44 | 17.54 | 1.26 | 33.69 | 37.39 | 1.00 | .16 | | 30.00 |
| Sorghum silage | 32.94 | 15.82 | 4.31 | 3.55 | 26.56 | 47.75 | .33 | .30 | | 10.00 |
| *Solvent vs. hydraulic meal* | | | | | | | | | | |
| Ground corn | 87.60 | 1.64 | 9.65 | 4.50 | 1.99 | 82.21 | .07 | .23 | | 66.07 |
| Cottonseed meal (hydr.) | 93.57 | 6.87 | 42.67 | 6.79 | 10.79 | 31.38 | .23 | .92 | | 93.00 |
| Cottonseed meal (solvent) | 92.26 | 6.48 | 43.10 | 0.63 | 13.16 | 36.30 | .22 | .78 | | 93.00 |
| Alfalfa hay | 91.71 | 10.88 | 17.68 | 1.84 | 31.79 | 38.47 | 1.16 | .17 | | 27.50 |
| Sorghum silage | 31.47 | 11.46 | 4.99 | 4.98 | 26.52 | 51.06 | .75 | .39 | | 8.00 |
| *Effect of carotene study* | | | | | | | | | | |
| Ground corn | 88.38 | 1.57 | 10.56 | 5.30 | 2.15 | 80.41 | .04 | .31 | 1.5 | 58.68 |
| Cottonseed cake | 92.98 | 6.45 | 43.06 | 6.53 | 11.56 | 32.41 | .22 | .90 | | 77.00 |
| Carotene pellets[3] | 92.27 | 5.94 | 43.38 | 7.58 | 11.76 | 31.32 | .32 | .89 | 13.7 | 87.00 |
| Alfalfa hay | 91.48 | 8.91 | 16.55 | 2.69 | 36.20 | 35.63 | 1.16 | .22 | 7.3 | 19.83 |
| Sorghum silage | 33.62 | 8.24 | 5.47 | 2.65 | 26.45 | 57.19 | .36 | .23 | 2.2 | 5.67 |

[1] Cost of salt in most trials was $15.00 per ton; steamed bone meal, $96.00, and ground limestone, $15.00.
[2] Atlas and Honey Drip varieties.
[3] Carotene pellets contained cottonseed meal plus a crude carotene product derived from alfalfa.

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