

A STUDY OF THE OPTIMUM LEVEL OF COTTONSEED CAKE
IN FATTENING RATIONS FOR STEER CALVES

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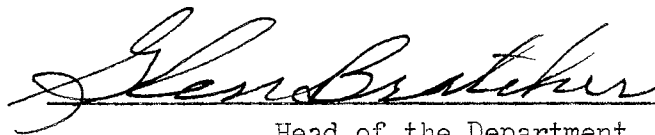
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INTRODUCTION

It is an established fact that all animals must receive a certain minimum amount of protein in the diet. Proteins are the only major constituent of feedstuffs (proteins, fats and carbohydrates) that supply nitrogen. This nitrogen, in the form of amino acids, is an essential part of all living tissues, as well as the enzymes by which organisms break-down and utilize foods. While there are certain amino acids which are essential for simple-stomached animals, it is fortunate that the ruminant can obtain ample quantities of these by virtue of bacterial synthesis in the rumen. Consequently, the feeding of complex protein mixtures for the purpose of supplying all the essential amino acids is apparently not as important in feeding cattle as it is in the nutrition of non-ruminants.

However, the amount of protein supplement necessary in beef cattle rations and therefore the most profitable level to feed remains open to question. In fattening rations, for example, an adequate amount of protein supplement is essential for rapid gains, efficient use of other feeds in the ration, and a desirable degree of finish. Since the grains and roughages commonly used to fatten cattle may be produced on the farm, the protein supplement is often the only feed which must be purchased, and thus it is necessary to know how much is required by fattening cattle in order to realize the most profit from the feeding operation. Likewise, the question is often raised by cattle feeders as to whether it is better to feed the same amount of protein supplement throughout the fattening period, or to vary the amount fed in an attempt to better meet the needs of the cattle.

In the southwest, cottonseed meal is the most common protein supplement used in fattening rations for cattle. Recently a new method of solvent extraction has been developed which makes it possible to remove nearly all of the fat in the cottonseed meal. Large quantities of cottonseed meal processed by this method are now available to the cattle feeder. Thus, it seemed desirable to study the nutritive value of this new solvent cottonseed meal as compared to the common hydraulic or expeller meals in fattening rations for beef calves.

To further study some of these factors concerning the use of protein supplements, six trials were conducted during 1950-53 with steer calves fattened in dry lot in which (a) the optimum level of protein supplement in fattening rations for steer calves, (b) the effect of varying the level of cottonseed meal fed during the fattening period, and (c) hydraulic vs. solvent-extracted cottonseed meals were investigated.

REVIEW OF LITERATURE

Livestock can metabolize high levels of protein in a complete diet for long periods without harmful effects, according to Maynard (1947). Also, protein in excess of that which the body can use tends to be wasted insofar as its specific function as a protein is concerned. Since protein supplements usually cost more per pound than grains and must be purchased in most cases, it is necessary for the livestock producer to feed the minimum level of supplement without impairing production, if the most profit from the feeding operation is to be realized.

Importance of Protein in Fattening Rations

According to Morrison (1951), a protein supplement is especially needed in rations for fattening beef calves because of their high protein requirement per pound of body weight. Especially is this true if no legume hay is present in the ration. He has summarized the results of eight experiments in which the addition of 1.5 pounds per head daily of linseed meal or cake to a ration of corn, alfalfa hay and corn silage increased the average daily gain of steers from 2.01 pounds on the basal ration to 2.29 pounds, and increased the selling price of the cattle by \$.42 per 100 pounds.

Skinner and King (1938), at the Purdue station, conducted three consecutive fattening trials with steer calves to determine the need for cottonseed meal as a protein supplement to a ration of corn, clover hay and corn silage. The average daily gain of the unsupplemented calves for

the three trials was 1.78 pounds, while the average daily gain of steers receiving an average of 1.51 pounds cottonseed meal per head daily was 2.11 pounds. The efficiency of feed utilization for calves fed the rations supplemented with cottonseed meal was greatly improved over those that were unsupplemented.

From the results of several feeding trials, Peters (1933) concluded that the addition of about 1.5 pounds of protein supplement per head daily improved a ration of corn, legume hay and corn silage for fattening steer calves.

An experiment in which two lots of steer calves and two lots of heifer calves were fed a basal ration of shelled corn, legume hay and corn silage was reported by Thalman (1943) at the Nebraska station. One lot of each sex was supplemented with 1.8 pounds of cottonseed meal per head daily. The two remaining lots received only the basal ration. The average daily gain of the calves receiving cottonseed meal was increased by 0.13 pound and 0.15 pound for the steers and heifers, respectively, over those receiving no supplement. The efficiency of feed utilization by the steers was not improved by the addition of cottonseed meal but feed utilization by the heifers receiving the protein supplement was slightly improved. The steers and heifers that received a protein supplement were fatter and sold at a higher price than those receiving no supplement, hence returned more profit from the fattening operation.

In a series of six fattening trials with steer calves, Branaman (1936) at the Michigan station found that the addition of 1.3 pounds of linseed oil meal to a basal ration of corn or corn and oats, corn silage and alfalfa hay increased rate of gain and feed efficiency of the cattle.

The calves receiving the protein supplement made an average daily gain of 2.20 pounds per steer while those receiving the basal ration gained only 1.97 pounds per head daily.

The importance of a protein supplement in a steer fattening ration is evident from the work of Burroughs and Gerlaugh (1949). They found that the apparent digestibility of corn cob dry matter was increased from 58.9 to 66.7 per cent when the protein content of the ration was increased from 8 per cent to 15 per cent by substituting soybean oil meal for ground shelled corn. The apparent digestibility of timothy hay was likewise increased from 50.7 to 59.1 per cent.

Gallup and Briggs (1948) conducted digestion trials with steers fed ten pounds of prairie hay and 0.0, 0.5, 1.0, 1.5, 2.0, 2.3 and 3.0 pounds of cottonseed meal per head daily. The digestibility of each ration was determined with at least four steers. The digestibility of all nutrients was greatest in the ration containing the largest amount of protein and varied directly with the protein content.

Burroughs et al., (1949) in five series of digestion trials with steers, found that the addition of dried skimmilk improved roughage digestion in all cases where starch formed a part of the ration. Little or no improvement in corn cob digestion was obtained when dried skimmilk was added to a ration containing no starch. From their work, they advanced the theory that the protein fed to cattle and other ruminants serves two separate functions. One function pertains to the growth and development of microorganisms in the digestive tract and is associated with roughage digestion and the synthesis of B-vitamins and amino acids. The other function is related to the growth of the ruminant's body.

According to Snapp (1952), one of the benefits derived from adding a protein supplement to a ration of corn and alfalfa hay is its appetite-stimulating effect as the cattle approach a desirable market grade.

There have been times when cottonseed meal has sold at a price equal to, or less than, grain. When such price relationship exists, questions have arisen as to whether cottonseed meal can be fed in large amounts over long periods without harmful effects. Also, it is desirable to know what the comparative values of cottonseed meal and common grains are when fed at high levels to fattening steers in dry lot.

Blizzard and Taylor (1940) found that when cottonseed cake replaced corn in a fattening ration at levels of 5.38 pounds per day, the cake was worth only 89.6 per cent as much as corn in producing 100 pounds of steer gain at the prevailing feed prices. Taylor (1940) found that to produce 100 pounds gain in fattening steer calves, 182 pounds of cottonseed cake replaced 210 pounds of corn, but required an additional 10 pounds of oats and 14 pounds of silage. The cost per cwt. gain was \$7.10 for steers fed the corn ration, and \$8.34 for those fed the cottonseed cake ration, although average daily gains were 2.14 and 2.26 pounds per steers, respectively. Blizzard (1938, 1939b) conducted two feeding trials with steer calves full-fed corn and limited amounts of prairie hay, and supplemented with 1.95 pounds of cottonseed cake per head daily, as compared to one-half a full-feed of corn and all the cottonseed cake they would consume. An average of the results of two trials show that 94.7 pounds of cottonseed cake replaced 100 pounds of corn where the greater amount of cottonseed cake was fed. The corn ration produced the most economical gains.

McC Campbell et al., (1926) full-fed cottonseed meal to steer calves as the only concentrate in a fattening ration, as compared to 1.0 pound of cottonseed meal and enough ground shelled corn to equal the amount of cottonseed meal consumed by the first lot. Both lots were fed the same amounts of alfalfa hay and silage. The average daily consumption of concentrate was 11.04 pounds per steer. The average daily gain of the cottonseed meal steers was 2.39 pounds, as compared to 2.43 pounds for steers fed corn and 1.0 pound of cottonseed meal. The steers full-fed cottonseed meal produced 100 pounds of gain at a cost of \$13.14, as compared to \$11.88 for those fed corn and cottonseed meal. However, the steers fed cottonseed meal as the only concentrate were appraised at \$.25 per hundred-weight more than the corn-fed steers.

Mississippi workers (1944) conducted a feeding trial with 470-pound steer calves to compare cottonseed cake and cottonseed meal when full-fed, or when fed in limited amounts. All lots were fed a basal ration of 6.5 pounds sorghum silage, 3 pounds alfalfa hay and 0.2 pound of oystershell flour per calf daily. Each of two lots were fed 8 pounds of cottonseed cake or cottonseed meal per head daily plus all the corn they would consume. The remaining two lots were full-fed cottonseed cake or cottonseed meal. The steers full-fed cottonseed cake or cottonseed meal lost \$2.18 and \$2.77 per steer while the steers on limited amounts of cottonseed cake or cottonseed meal made satisfactory gains and showed a profit of \$8.57 and \$10.52 per steer, respectively.

Knox and Neale (1939) conducted a series of feeding trials with yearling steers to determine the value of cottonseed meal as the only source of concentrate when fed with alfalfa hay and corn silage. Gains were

satisfactory and no ill effects were noted when steers were consuming 14 pounds of cottonseed meal per head daily.

In summary, the need for a protein supplement in fattening rations for beef calves fed corn, silage and limited amounts of legume hay has been shown to be necessary to promote rapid and economical gains and improve carcass quality. The addition of a protein supplement to such rations increases the digestibility of the rations, thus, more nutrients are available for rapid and efficient gains. Cottonseed meal can be fed at high levels without ill effects. At levels above those needed for proper supplementation of the ration, however, no improvement in rate of gain can be expected.

Level of Protein Supplement in Rations for Beef Cattle

McC Campbell and Horlacher (1924) conducted an experiment at the Kansas station to determine the amount of cottonseed cake that should be fed to steer calves receiving a full feed of shelled corn, cane silage and two pounds of alfalfa hay per head daily. Five lots of ten steer calves each were fed the same basal ration and were supplemented with 0.0, 0.5, 1.0, 1.5 and 2.0 pounds cottonseed cake per head daily. Average daily gains were 1.84, 1.98, 2.06, 2.07 and 2.12 pounds, respectively. The steers fed 1.0 pound of cottonseed cake per head daily returned the greatest profit per head. McC Campbell et al., (1925) conducted an additional trial in which steer calves were fed a basal ration of 2 pounds of alfalfa hay per head daily and all the shelled corn and sorghum silage they would consume. One lot received only the basal ration, while two lots were fed the basal ration and either 0.9 pound or 1.69 pounds of cottonseed meal

per head daily. Average daily gains were 1.88, 2.12 and 2.10 pounds, respectively. The steers fed 0.9 pound of cottonseed meal per head daily returned a greater profit per steer than those fed none or 1.69 pounds of cottonseed meal per head daily.

Blizzard (1939a) summarized the results of four fattening trials with steer calves fed a basal ration of ground shelled corn, prairie hay and ground limestone and supplemented with either 1.5, 2.5 or 3.5 pounds of cottonseed meal. Average daily gains were 2.09, 2.14 and 2.09 pounds, respectively. A summary of the average results of four trials is given in the following table.

	Level of Cottonseed Meal Fed Daily		
	1.5 lbs.	2.5 lb.	3.5 lb.
Ave. no. of steers per lot	9	9	9
Ave. initial wt. (lbs.)	398	396	396
Ave. daily gain (lbs.)	2.09	2.14	2.09
Ave. daily ration (lbs.)			
Ground shelled corn	8.60	7.74	6.84
Cottonseed meal	1.45	2.47	3.52
Prairie hay	4.19	4.21	4.26
Kafir silage*	6.69	6.93	6.64
Ground limestone	.19	.18	.17
Feed required per cwt. gain			
Concentrates	481	477	496
Roughage	227	224	230
Dressing percentage	58.8	58.9	58.6

*Silage was fed in place of prairie hay in one trial.

There was very little difference among the lots in feed required per 100 pounds gain, nor was there a significant difference in dressing percentage. These results indicate that approximately 1.5 pounds of cottonseed cake per head daily will supply the supplemental protein needed in this type ration and that feeding levels above this will be profitable only when cottonseed meal sells at a lower price than corn.

Gerlaugh (1938) reported the results of a series of three fattening trials with steer calves fed a basal ration of shelled corn, corn silage and mixed clover-timothy hay. A 45 per cent protein supplement containing 30 parts tankage, 30 parts soybean oil meal, 20 parts cottonseed meal, 15 parts linseed meal, 2 parts ground limestone, 2 parts steamed bonemeal, and 1 part salt was fed at levels of 0.8, 1.6 and 2.4 pounds per head daily. The level of 0.8 pound per head daily was not adequate under the conditions of this study and was not fed the third year. One and six-tenths pounds of supplement produced very satisfactory gains and was the most economical level in these tests. Two and four-tenths pounds of supplement per head daily resulted in greater weight gain and more highly finished steers at the completion of the test, but the difference in selling price was not enough to justify the higher feed cost as compared to the 1.6 pound level.

Texas workers (1950) conducted an experiment in which yearling steers were fed a basal ration of ground milo heads and silage with no additional protein, as compared to 2.46 or 4.91 pounds of cottonseed meal per head daily. The steers receiving no supplement produced 100 pounds of gain at the lowest cost of any of the lots but had poor hair coats and appeared to lack finish at the completion of the trial. The steers fed 2.46 pounds of cottonseed meal made satisfactory gains at a relatively low cost per hundredweight gain, and when sold were highly finished and showed adequate bloom. The steers fed 4.91 pounds of cottonseed meal per head daily made greater gains than any other lot, but there was not enough difference in selling price to compensate for the cost of the additional protein supplement.

Klosterman et al., (1953) conducted an experiment with yearling steers fed corn and cob meal, good quality mixed clover and timothy hay

and none, 0.75 and 1.5 pounds of soybean oil meal per head daily. In addition, two lots were supplemented with 0.75 and 1.5 pounds of soybean oil meal, with 1.0 pound of molasses added at each level of supplement fed per steer daily. The average daily gains were 1.63, 1.79 and 1.94 pounds for the steers fed none, 0.75 and 1.5 pounds of soybean oil meal, respectively, and 2.05 and 2.00 pounds for those fed 0.75 and 1.5 pounds of soybean oil meal and 1.0 pound of molasses, respectively. When the steers received only soybean oil meal as a supplement, average daily gains, feed utilization, carcass grade and dressing percentage decreased as the amount of soybean oil meal fed decreased. When supplemented with molasses, the steers fed 0.75 pound soybean oil meal produced results equal to those fed 1.5 pounds of soybean oil meal, either with or without additional molasses.

Weber et al., (1950) conducted three trials with beef calves wintered on silage and 0.5 or 1.0 pound of cottonseed cake per head daily. The average daily silage consumption during the three trials was 38 pounds per calf. The steers fed 0.5 pound of cottonseed cake made an average daily gain of 0.56 pound per head, while those fed 1.0 pound gained 0.74 pound daily.

Weber (1945) found that the addition of 1.0 pound and 2.0 pounds of cottonseed meal to the daily ration of steer calves wintering on prairie hay resulted in average daily gains of 0.58 and 0.99 pound per head, respectively. Feed cost per 100 pounds of gain for the steers fed 2.0 pounds of cottonseed meal was \$18.74, as compared to \$27.29 for steers fed 1.0 pound of cottonseed meal daily.

Varying the Amount of Protein Supplement

Gerlaugh (1938) reported the results of three feeding trials with steer calves in which the amount of protein supplement was increased or decreased as the trial progressed. The supplement used in these experiments was composed of 30 parts tankage, 30 parts soybean oil meal, 20 parts cottonseed meal, 15 parts linseed meal, 2 parts ground limestone, 2 parts steamed bonemeal and 1 part salt. The basal ration fed to all lots contained a full-feed of ground shelled corn and a limited amount of corn silage and mixed clover-timothy hay. Twenty Hereford steer calves, averaging about 350 pounds, were used in each lot. The amount of protein supplement fed per head daily was as follows:

Lot 1 -- 1.6 pounds throughout the trial.

Lot 2 -- 2.4 pounds throughout the trial.

Lot 3 -- 2.4 pounds for the first 24 weeks and 1.6 pounds for the remaining 20 weeks of the trial.

Lot 4 -- 1.6 pounds for the first 24 weeks and 2.4 pounds for the last 20 weeks of the trial.

Lot 5 -- 0.8 pound the first 12 weeks, 1.6 pounds the next 12 weeks, 2.4 pounds the third 12 weeks and 3.2 pounds the last 8 weeks.

In each instance, when the calves of Lots 4 and 5 were shifted to a higher level of protein supplement, an immediate increase in daily gain was noted. When the amount of supplement was decreased from 2.4 to 1.6 pounds, the decrease in daily gain was not immediately apparent, but total gains for the period were reduced. The calves that were fed higher levels of supplement during the early part of the trial (Lot 3) made more rapid growth but

showed no more thickness of flesh until the feeding trials had progressed about 6 months. No advantage was obtained in average daily gain or feed efficiency by reducing the amount of protein supplement as the feeding trial progressed. The calves that were started on 0.8 pound of protein supplement per head daily and increased to 3.2 pounds per head daily did not make as much growth as those fed 2.4 pounds daily throughout the trial, however, they appeared equally as fat at the completion of the trial.

Knox and Neale (1939) reported three fattening trials with yearling steers fed corn silage, alfalfa hay and cottonseed meal. One lot was fed an average of 9.51 pounds of cottonseed meal per head daily throughout the trial and was compared to a lot receiving about 2.5 pounds of cottonseed meal per head daily for the first 12 weeks and heavy feeding of cottonseed meal during the remaining 12 weeks. The latter method produced more economical gains but the steers sold at a lower price, yielded lower dressing percentages and had lower-grading carcasses. There was \$.22 more profit per steer in favor of those fed 9.51 pounds cottonseed meal daily throughout the trial.

Methods of Processing Cottonseed Meals as They Affect the Nutritive Value

The practice of solvent extraction of cottonseed is becoming increasingly common due to the higher price of the oil in relation to the meal and because of the development of new techniques which increase the efficiency of the method. If the level of fat in cottonseed meal is of nutritional importance, this fact must be considered when choosing between hydraulic and solvent-processed meals, even though the amount of meal in the total ration may be small. Willey et al., (1952) found that feeding

high-fat rations to fattening steers had a beneficial effect upon efficiency of feed utilization, however they found no improvement in rate of gain or carcass grade.

The fat content may not be the only factor affected by the solvent extraction of oil from cottonseed. The nutritive value of the protein may also be changed. Rusk and Snapp (1937) found no significant difference in biological value of the proteins of hydraulic and solvent-processed soybean meals when fed to cows. Gallup et al., (1950) found no significant difference in the nitrogen retention of steers and lambs due to the method by which the cottonseed meal was processed when hydraulic or solvent-processed cottonseed meal was included in a maintenance ration of prairie hay, or a fattening ration of prairie hay and corn. They reported no marked difference in nutrient digestibility between similar rations made up of the two differently processed meals. The digestibility of all nutrients except crude fiber was greater in the fattening rations than in the maintenance rations.

Texas workers (1950) conducted an experiment in which two lots of seven steers each were fed 4 pounds per head daily of either hydraulic or solvent-processed cottonseed meal in addition to a basal ration of 5.5 pounds of ground sorghum grain and 48 pounds of sorghum silage. The steers fed hydraulic-processed cottonseed meal made an average daily gain of 2.20 pounds per steer during the 142-day trial, as compared to 2.06 pounds for steers fed solvent processed cottonseed meal. The steers fed the solvent-processed meal sold at a slightly higher price, accounting for the near equal returns per lot.

Marion et al., (1950) fed 4 pounds of hydraulic or solvent-processed cottonseed meal as supplements to a fattening ration for yearling steers

receiving a full feed of sorghum silage, limited amounts of grain and alfalfa hay. In a 126-day trial, the steers fed hydraulic-processed meal made an average daily gain of 2.83 pounds as compared to 2.63 pounds for steers fed solvent-processed meal, but this difference was not statistically significant. There was very little difference in carcass grade, dressing percentage, or feed efficiency. This feeding trial was repeated the following year by Marion et al., (1951) with similar results.

Riggs et al., (1950) wintered two lots of 19 purebred cows each on improved pasture and silage. The cows in one lot received 2 pounds of hydraulic-processed cottonseed meal as compared to 2 pounds of solvent-processed cottonseed meal fed the other lot. There was no significant difference in weight gains of the cows, but the calves from the cows fed hydraulic-processed meal averaged 202 pounds at an average age of 78 days, at which time the experiment was terminated, as compared to 180 pounds for calves from the cows fed solvent-processed meal. This gave the calves from the cows fed solvent-processed cottonseed meal a 22-pound advantage, even though they were 7 days younger on the average.

Pope et al., (1952) supplemented two lots of 20 yearling steers per lot with 1.5 pounds of hydraulic or 1.5 pounds of solvent-extracted cottonseed meal while wintering on dry, native grass. In the 135-day wintering period, the steers receiving hydraulic cottonseed meal made an average total gain of 13 pounds per steer while those receiving solvent cottonseed meal gained 25 pounds per steer. Further studies by Pope et al., (1953) with two-year-old steers wintered on dry, native grass and 2.0 pounds of supplement per head daily for a 125-day period showed a slight advantage for those fed hydraulic cottonseed meal. The steers receiving hydraulic

cottonseed meal lost 21 pounds per head during the winter period as compared to a loss of 25 pounds for steers receiving solvent cottonseed meal.

Marion et al., (1952) fed 2.57 pounds of either hydraulic or solvent-processed cottonseed meal in a ration containing 2.20 pounds ground alfalfa hay, 5.2 pounds of ground sorghum grain and 43 pounds of sorghum silage to yearling steers in a 168-day fattening test. The steers receiving hydraulic-processed meal made an average daily gain of 2.21 pounds as compared to 2.14 pounds gain by the steers receiving solvent processed meal. Feed efficiency was in favor of the steers receiving hydraulic-processed meal.

Thus, it would appear from the research to date that the different methods of processing cottonseed meals may have some effect on their nutritive value in fattening rations. Results with maintenance-type rations have been less consistent. Further research is needed to more clearly establish their relative feeding value, particularly in fattening rations where maximum gain is desired.

EXPERIMENTAL

Objectives

An experiment involving a total of six trials with steer calves fattened in dry lot was conducted during the period 1950-53 with the following objectives:

1. To determine the optimum level of protein supplement in rations of corn, cottonseed cake, alfalfa hay and sorghum silage for fattening steer calves in dry lot.

2. To study the advisability of gradually reducing the amount of protein supplement fed steer calves during the fattening period, as compared to feeding the same average amount throughout the trial.

3. To compare hydraulic and pre-press solvent-extracted cottonseed meals as protein supplements in fattening rations for steer calves.

Procedure

A total of 110 choice, weanling, Hereford steer calves were used in the feeding trials reported herein. In 1950-51, the calves were purchased from the Mullendore Trust Company ranch near Fairfax, Oklahoma, where it was possible to obtain a uniform group of calves out of a large number weaned. In the 1951-52 trials, eight of the ten calves used in each lot were produced in the experimental herd at Lake Carl Blackwell and Ft. Reno, and two were from a load purchased at the Oklahoma City Feeder Calf sale. In the 1952-53 trials, nine calves in each lot were from a uniform group purchased from the E. C. Mullendore ranch at Pawhuska, Oklahoma, and

one calf was from the experimental herd at Lake Carl Blackwell. On arrival at the experimental steer shed at Stillwater, the calves were given approximately three weeks to become accustomed to the change in environment and feed, and to recover from weaning before being placed on the experimental rations. In all trials, the calves were allotted into uniform groups of ten head each on the basis of weight, expected outcome and source. The experimental rations to be fed were then assigned the groups at random.

The steers of each lot were confined to concrete paved pens approximately 30 by 50 feet in size and had access to an open shed. The feed bunks in each lot were placed under the open shed. The steers in all lots were hand-fed a ration of ground shelled corn, varying amounts of protein supplement, a limited amount of sorghum silage and one pound of alfalfa hay per head daily. The calves were gradually worked up to a full feed of corn and then fed all they would clean up by the next feeding. The amount of silage fed was gradually reduced to assure a maximum intake of corn. The alfalfa hay was fed once daily in separate racks at the time of the morning feeding. The concentrates and silage were fed twice daily in an open bunk. Refused feed was weighed back, although the daily allowance was adjusted so that the steers consumed almost all of the feed offered. In the first two trials, the steers had free access to salt and a mineral mixture of equal parts ground limestone, steamed bonemeal and salt. In the 1952-53 trial, the steers had access to a mineral mixture composed of two parts salt and one part steamed bonemeal.

Two trials were conducted during 1950-52 in which 0.5, 1.0 or 1.5 pounds of cottonseed cake per head daily were fed as supplements to a full feed of corn, and limited amounts of alfalfa hay and sorghum silage.

The effect of varying the level of cottonseed cake in the ration by feeding larger amounts at the start of the trial and reducing the amount fed at approximately 60-day intervals was studied in two trials. In the first trial (1951-52), one lot of steers was fed 1.5 pounds of cottonseed cake per head daily during the first 56 days, 1.0 pound per head daily during the next 56 days, and 0.5 pound per head daily for the remainder of the trial. This provided an average intake of approximately 1.0 pound per steer daily, which was comparable to that received by the control lot which was fed the same amount throughout the trial. In the second trial (1952-53), the same procedure was followed in the experimental lot with 0.5 pound reductions at 60-day intervals from the initial level of 2.0 pounds to provide an average intake of approximately 1.5 pounds per head daily. The control lot received 1.5 pounds of protein supplement per head daily throughout the trial.

Two trials were conducted during 1951-53 in which hydraulic-processed cottonseed meal was compared to a new pre-press solvent-extracted cottonseed meal when each was fed at the level of 1.5 pounds per steer daily. The solvent meal was obtained from mills at Sherman and Abilene, Texas, in successive years and was very low in fat content.

In all trials, the initial and final weights were an average of three consecutive daily weights taken in the afternoon. The steers were weighed at 28-day intervals during the first two trials and at 21-day intervals during the 1952-53 trial.

The market value of the steers in each lot was determined at the completion of each trial by a committee composed of packer and commission company representatives from the Oklahoma City livestock market.

The cattle were sold on the Oklahoma City market shortly after the completion of the trial and shrink to market, selling price, dressing percentage, and carcass grades were obtained.

The weight gains of the steers were subjected to an analysis of variance (Snedecor, 1946).

RESULTS AND DISCUSSION

The results obtained in a two-year study of the response of fattening steer calves to different levels of protein supplement are presented in Table 1. The chemical composition of the feeds used and the feed prices by years are shown in Tables 9 and 10, Appendix.

The average daily gains for the steers of Lots 1, 2 and 3 which were supplemented with 1.5, 1.0 or 0.5 pounds of cottonseed cake per head daily, were 2.20, 2.02 and 1.89 pounds, respectively. Thus the average daily gains made by the steers varied directly with the level of protein supplement fed, and the differences observed were statistically significant at the one percent level (Table 2). The average cost of feed required to produce 100 pounds gain was \$19.11 for the steers fed 1.5 pounds of supplement daily, \$19.73 for those fed 1.0 pound, and \$19.42 for those fed 0.5 pound of cottonseed cake. In the same order, the average amount of corn required to produce each hundred pounds of gain was 500, 539 and 553 pounds. Furthermore, the average appraised market value was \$35.50, \$34.95 and \$34.50 per hundred-weight for steers of Lots 1, 2 and 3, respectively. The steers fed 1.5 pounds of cottonseed cake per head daily were slightly fatter at the completion of the trials than steers of the other lots, as indicated by their appraised market value and carcass grades.

Due to increased gains, lower feed cost per 100 pounds gain, and higher appraised value, the steers fed 1.5 pounds of cottonseed cake per head daily (Lot 1) returned more profit than either Lots 2 or 3. The average return per steer was \$47.14, \$32.05 and \$30.23 for Lots 1, 2, and 3, respectively. These results are in agreement with those obtained by

Table 1. Results Obtained in a Study of the Optimum Level of Cottonseed Cake in Fattening Rations for Steer Calves.
(Average of two trials, 1950-52, 171 days on test.)

	Level of Cottonseed Cake Fed per Steer Daily (lbs.)		
	1.5	1.0	0.5
Total number of steers	19 ¹	20	20
Average weight (lbs.)			
Initial	470	468	469
Final	846	813	792
Total gain	376	345	318
Average daily gain	2.20	2.02	1.89
Average daily ration (lbs.)			
Ground shelled corn	10.98	10.87	10.53
Cottonseed cake	1.50	1.00	0.50
Alfalfa hay	1.00	1.00	1.00
Sorghum silage	7.31	7.29	7.25
Salt	.03	.04	.03
Mineral mixture ²	.04	.04	.04
Feed/cwt. gain (lbs.)			
Ground shelled corn	500	539	553
Cottonseed cake	69	50	27
Alfalfa hay	46	50	53
Sorghum silage	333	361	384
Feed cost/cwt. gain (dollars)	19.11	19.73	19.42
Financial results (dollars)			
Appraised value/cwt.	35.50	34.95	34.50
Total value/steer (3% shrink)	291.22	271.72	264.83
Initial cost/steer	172.21	171.43	171.60
Feed cost/steer	71.87	68.26	63.00
Total cost/steer	244.08	239.69	234.60
Return/steer	47.14	32.05	30.23
Carcass grades			
U.S. Prime	3		1
U.S. Choice	16	17	18
U.S. Good		3	1

¹One steer removed due to factors unrelated to ration fed and was not included in the above data (1951-52).

²Mineral mixture included equal parts of salt, bone meal and ground limestone.

Table 2. Analysis of Variance and Orthogonal Comparison of Average Daily Gains on Various Levels of Cottonseed Cake.
(Average of two trials, 1950-52, 171 days on test.)

Analysis of Variance		
Source	d.f.	m.s.
Total	58	
Treatment	2	.4684**
Years	1	.0759
Within lots	55	.0510

Orthogonal Comparison		
Source	d.f.	m.s.
Treatment	2	
Lot 1 vs. 2 and 3	1	.8079**
Lot 2 vs. 3	1	.1288
Within lots	55	.0510

**Significant at the 1% level.

Gerlaugh (1938) and Klosterman (1953) at the Ohio station who found that the rate of gain and profit per steer was directly related to the amount of protein supplement fed up to the level necessary for satisfactory performance.

A summary of the results obtained in the four feeding trials which have been conducted at this station from 1948 to 1952, to study the effect of different levels of cottonseed cake in fattening rations, are summarized in Table 3. The average daily gains for the four-year study were 2.16, 2.08 and 1.98 pounds for steers fed 1.5, 1.0 and 0.5 pounds of cottonseed cake, respectively. An analysis of variance, as shown in Table 4, revealed that the increased gains of steers receiving 1.5 pounds of cottonseed cake per head daily, as compared to those fed 1.0 and 0.5 pound, were significant

Table 3. Results Obtained in a Study of the Optimum Level of Cottonseed Cake in Fattening Rations for Steer Calves.¹
(Average of four trials, 1948-52, 173 days on test.)

	Level of Cottonseed Cake Fed per Steer Daily (lbs.)		
	1.5	1.0	0.5
Total number of steers	38 ²	40	40
Average weight (lbs.)			
Initial	488	487	488
Final	864	847	830
Total gain	376	360	340
Average daily gain	2.16	2.08	1.98
Average daily ration (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
Mineral mixture ³	.04	.04	.04
Feed/cwt. gain (lbs.)			
Ground shelled corn	515	547	560
Cottonseed cake	70	49	26
Alfalfa hay	47	48	51
Sorghum silage	320	333	348
Feed cost/cwt. gain (dollars)	18.35	18.50	18.10
Financial results (dollars)			
Appraised value/cwt.	31.06	30.73	30.38
Total value/steer (3% shrink)	259.54	249.16	242.93
Initial cost/steer	154.42	154.03	154.11
Feed cost/steer	69.04	66.50	61.86
Total cost/steer	223.46	220.53	215.97
Return/steer	36.08	28.63	26.96

¹Includes the 1948-49 and 1949-50 trials reported by Maynard (1950). Since no carcass grades were obtained in these trials, no average carcass evaluation is possible for the four-year study.

²One steer removed from 1949-50 trial and from 1951-52 trial due to factors unrelated to ration fed and were not included in the above data.

³Mineral mixture included equal parts of salt, bone meal and ground limestone.

Table 4. Analysis of Variance and Orthogonal Comparisons of Average Daily Gains of Steers Fed Various Levels of Cottonseed Cake.
(Average of four trials, 1948-52, 173 days on test.)

Analysis of Variance		
Source	d.f.	m.s.
Total	117	
Treatment	2	.2794
Years	3	.0977
Within lots	112	.0687

Orthogonal Comparison		
Source	d.f.	m.s.
Treatment	2	
Lot 1 vs. 2 and 3	1	.4161*
Lot 2 vs. 3	1	.1427
Within lots	112	.0687

*Significant at the 5% level.

at the five percent level. These average results of four trials indicate that the optimum level of cottonseed cake in rations of the type fed steer calves in this study is 1.5 pounds per head daily.

Maynard (1950) has summarized the results of two previous trials (1948-50) with steer calves fed the same type of ration as used in this study. He found that steers fed 1.0 pound of cottonseed cake per head daily made greater daily gains and returned more profit per steer than those fed either 1.5 or 0.5 pounds of cottonseed cake. Steers fed the basal ration supplemented with 1.0 pound of cottonseed cake were not quite as fat as those fed rations containing 1.5 pounds of cottonseed cake, but the greater gains and lower feed cost per hundredweight gain resulted in slightly more profit per steer in the 1.0 pound level.

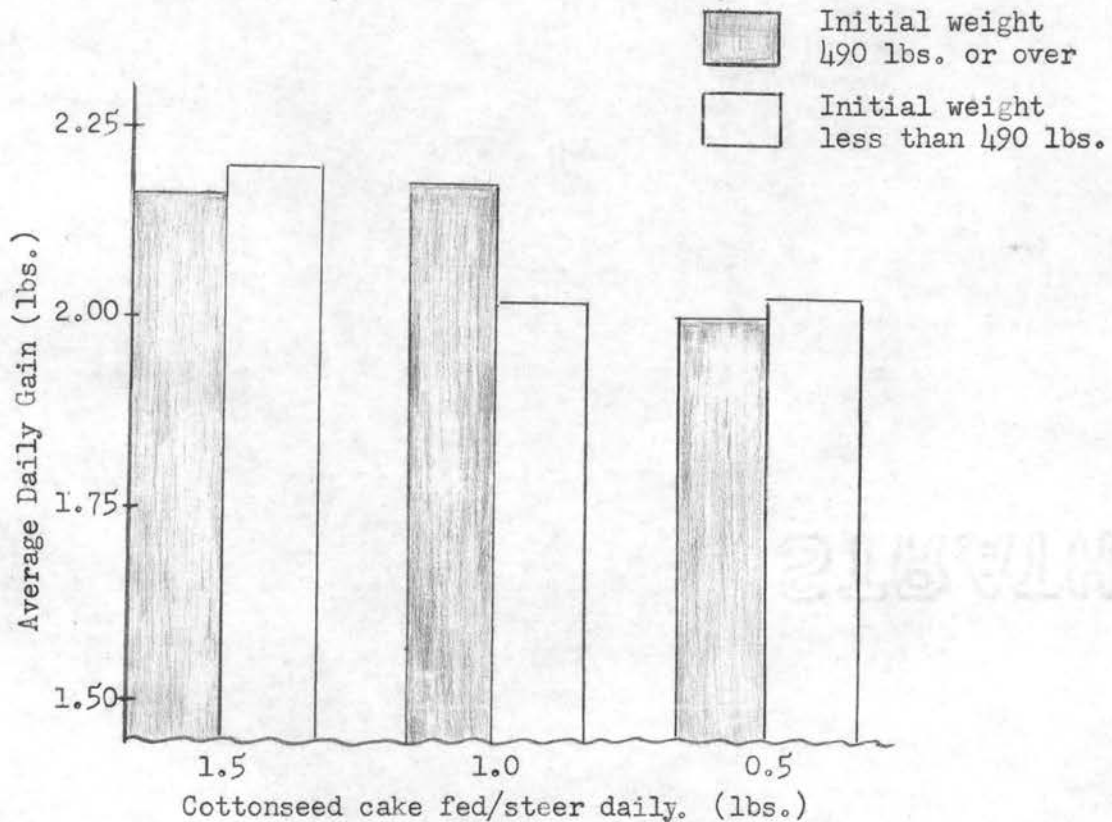
It seems possible that one reason for the lack of agreement as to the optimum level of cottonseed cake necessary in fattening rations as reported by Maynard (1950), from the results of the first two trials, and the subsequent trials reported herein, may have been due to a difference in initial weights of the calves used. Although there were no records of the birth dates of the calves used in these trials, it is probable that the calves in the first two trials were older than those in the last two trials. The average initial weight of the calves used in the first two trials was 506 pounds, while the calves used in the last two trials had an average initial weight of 470 pounds.

To study the possible effect of initial weight and level of cottonseed cake fed on average daily gain, the calves within each supplemental level during the four-year study (1948-52) were divided into two groups on the basis of initial weight. Calves with an initial weight of 490 pounds or more (average weight, 522 pounds) were placed in one group and their average daily gains were compared to those of calves having an initial weight of less than 490 pounds (average weight, 455 pounds) within the same treatment. A summary of the results obtained are presented in Table 5. From these data, it would appear that 1.5 pounds of cottonseed cake per head daily is the optimum level to feed steer calves that have an initial weight of about 455 pounds. It would appear that a level of 1.0 pound per head daily was satisfactory for calves having an initial weight of about 522 pounds, but inadequate for those whose average initial weight was 455 pounds. One-half pound of cottonseed cake per head daily would appear to be an inadequate amount of protein supplement for this type ration when fed to calves of either weight group. These results are further illustrated in Figure II.

Table 5. Average Daily Gains of Fattening Steer Calves as Influenced by Initial Weight and Level of Cottonseed Cake Fed.
(4 year average, 1948-52)

Levels of Cottonseed Cake Fed	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 lbs.	521	2.14	455	2.17
1.0 lb.	522	2.16	456	1.99
0.5 lb.	521	1.98	456	1.99

Figure I. Average Daily Gains of Fattening Steer Calves as Influenced by Initial Weight and Level of Cottonseed Cake Fed.
(4 year average, 1948-52)



From this, it would seem that older, heavier calves have a less critical protein need than younger, lighter calves fed the same type of basal ration.

From the examination of weight gains by 28-day periods, it was observed that calves fed the higher levels of cottonseed cake tended to make greater gains early in the fattening period. To illustrate this response of steer calves to different levels of protein supplement at various stages of the fattening trial, average daily gains by 28-day periods for steers fed 1.5, 1.0 and 0.5 pounds of cottonseed cake per head daily are presented in Table 6. For illustrative purposes, the results have been divided into the first and last parts of the feeding period and shown graphically in Figure II.

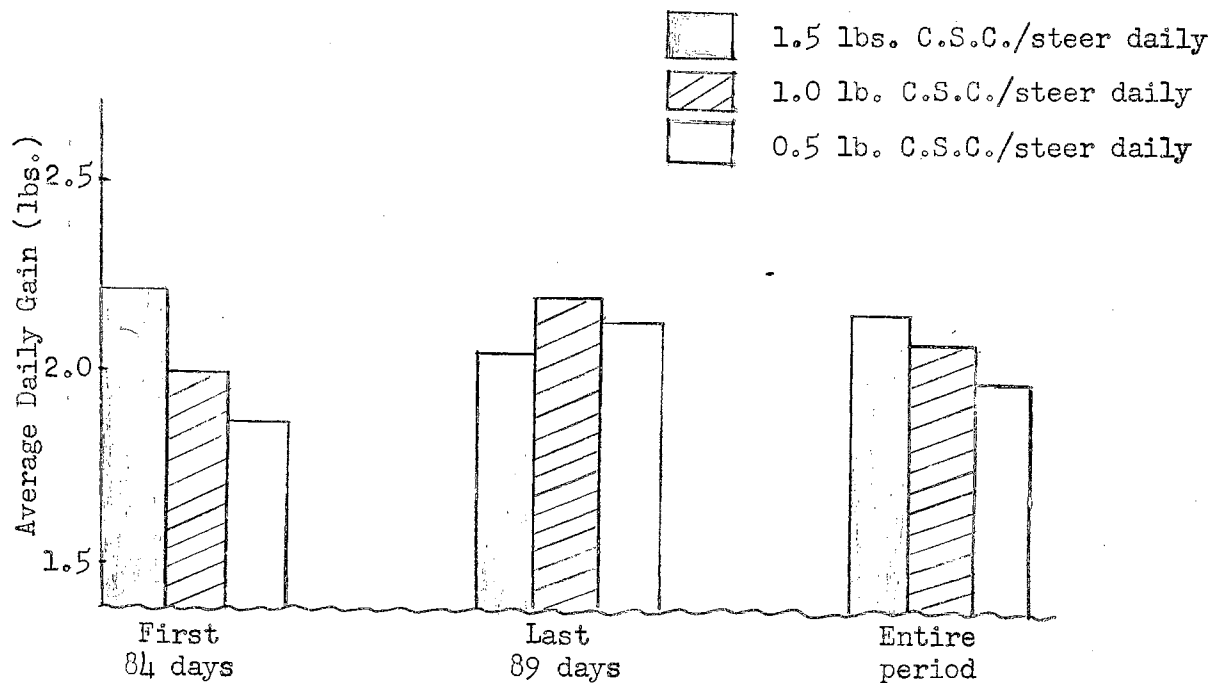
The steers fed 1.5 pounds of cottonseed cake per head daily made greater average daily gains during the early part of the trial than those fed 1.0 or 0.5 pounds of cottonseed cake. However, it was found that the steers fed 1.0 pound or 0.5 pound made greater average daily gains during the latter part of the trial. This would indicate the importance of protein in the ration of steer calves during the early part of the feeding trial. The fact that the steers fed 1.0 pound or 0.5 pound of cottonseed cake made greater daily gains during the last part of the fattening trial than those fed 1.5 pounds may have been due, in part, to their relatively poor gains during the early part of the feeding trial.

According to Snapp (1952), the level of 0.5 to 1.0 pound of linseed or cottonseed meal which is commonly fed to calves at the beginning of the fattening period is altogether too small to meet the needs of the young growing animals during the period following weaning. He further states: "Instead of starting with a small amount of protein concentrate and increasing it as the feeding trial progresses and the calves get older and

Table 6. Average Daily Gains by 28-day Periods for Fattening Steer Calves Fed Different Levels of Cottonseed Cake.
(4 year average, 1948-52)

	Level of Cottonseed Cake Fed per Steer Daily (lbs.)		
	1.5	1.0	0.5
Periods:	lbs.	lbs.	lbs.
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	2.16	2.08	1.98

Figure II. Average Daily Gains by Various Periods for Fattening Steer Calves Fed Different Levels of Cottonseed Cake.
(4 year average, 1948-52)



heavier, it would seem that a more sensible way would be to start with the larger quantity and gradually decrease the amount fed, or at any rate to feed a given amount, i.e., 1.5 to 2.5 pounds per head throughout the entire feeding period."

The Effect of Gradually Reducing the Level of Cottonseed Meal in Fattening Rations

The data presented in Table 6 and Figure II show that steer calves fed 1.0 or 0.5 pound of cottonseed cake per head daily in a fattening ration made as satisfactory gains during the last half of the feeding trial as those fed 1.5 pounds of cottonseed cake. This would indicate that it might be advantageous to reduce the amount of cottonseed cake as the fattening trial progresses as a means of conserving protein supplement.

The results obtained in two trials, in which the effect of gradually reducing the level of protein supplement in fattening rations for steer calves was studied, are presented in Table 7, with the composition of feeds and feed prices shown in Tables 9 and 10, Appendix. In the 1951-52 trial, the steers were fed 1.5 pounds of cottonseed cake per head daily during the first 56 days of the trial and the amount was reduced by 0.5 pound at each 56-day interval. Thus, the average daily consumption of protein supplement was about 1.0 pound. The average daily gain of the steers so fed was 1.99 pounds, as compared to 2.06 pounds for the steers fed 1.0 pound per head daily throughout the trial. The steers fed the ration in which the cottonseed cake was gradually reduced required slightly more corn and cottonseed meal per hundredweight gain than steers fed 1.0 pound throughout the trial, thus the feed costs per hundredweight gain were \$22.99 and \$22.21, respectively. The appraised market value slightly favored the steers fed the same

Table 7. Results Obtained in Two Trials Studying the Effect of Gradually Reducing the Level of Cottonseed Cake in Fattening Rations for Steer Calves. (1951-52 and 1952-53)

Method of Feeding Supplement	1951-52		1952-53	
	1.0 lb. per head daily throughout trial	1.5 lbs. per head daily reduced to 0.5 lb. ¹	1.5 lbs. per head daily throughout trial	2.0 lbs. per head daily reduced to 1.0 lb.
Number of steers/lot	10	10	10	9 ²
Average weight (lbs.)				
Initial	460	460	472	467
Final	814	802	838	825
Average daily gain	2.06	1.99	2.24	2.20
Average daily ration (lbs.)				
Ground shelled corn	11.13	11.08	10.90	10.82
Cottonseed meal	1.00	1.05	1.50	1.55
Alfalfa hay	1.00	1.00	1.00	1.00
Sorghum silage	7.72	7.76	7.92	7.40
Salt	.03	.02	---	---
Mineral mixture ³	.04	.02	.04	.04
Feed/cwt. gain (lbs.)				
Ground shelled corn	541	557	485	493
Cottonseed meal	49	53	67	71
Alfalfa hay	49	50	45	46
Sorghum silage	375	390	353	337
Feed cost/cwt. gain (dollars)	22.21	22.99	21.57	21.97
Financial results (dollars)				
Appraised value/cwt.	33.40	33.25	23.25	23.33
Total value/steer (3% shrink)	363.86	258.69	189.02	186.64
Initial cost/steer	181.01	181.01	132.16	130.76
Feed cost/steer	78.61	78.61	79.07	78.70
Total cost/steer	259.62	259.62	211.22	209.46
Return/steer	4.24	-.93	-22.20	-22.82
Carcass grades				
U.S. Prime		2		1
U.S. Choice	10	7	10	8
U.S. Good		1		

¹Protein supplement fed this lot in the 1951-52 trial was 1.5 pound per head daily for the first 56 days, 1.0 pound for the next 56 days, and 0.5 pound for the remainder of the period. In the 1952-53 trial, 2.0 pounds of supplement were fed for the first 60 days, 1.5 pound for the next 60 days, and 0.5 pound for the remainder of the trial.

²One steer removed from this lot due to a chronic bloat condition and is not included in the data.

³Mineral mixture fed contained equal parts of salt, ground limestone and bone meal in the 1951-52 trial, and two parts salt to one part bone meal in the 1952-53 trial.

level of cottonseed cake throughout the trial. The lot fed 1.0 pound of cottonseed cake per head daily throughout the trial produced ten choice carcasses, while those fed rations in which the level of protein supplement was gradually reduced yielded one good, seven choice and two prime carcasses.

In the 1952-53 trial, the steers of one lot were fed 2.0 pounds of cottonseed meal per head daily at the start of the trial, and this amount was reduced by 0.5 pound at the end of each 60-day period so that the average daily consumption was about 1.50 pounds. The average daily gain for steers so fed was 2.20 pounds, while those fed 1.5 pounds per head daily throughout the trial gained 2.24 pounds (see Table 7). The steers fed the varied amount of protein supplement required slightly more corn per hundredweight gain and the cost of feed per hundredweight gain was \$.40 more than for the control steers. However, their appraised market value was \$23.33 per hundredweight, as compared to \$23.25 for the steers fed 1.5 pounds of cottonseed meal per head daily throughout the fattening period. One prime and eight choice carcasses were produced in the lot fed the varied amount of supplement, as compared to ten choice carcasses produced by the lot fed 1.5 pounds throughout.

These results are similar to those obtained by Gerlaugh (1939), who conducted three fattening trials with steer calves fed rations in which the protein supplement was reduced from 2.4 pounds to 1.6 pounds per head daily at the end of 24 weeks in a 44-week fattening trial. He obtained no advantage from such a reduction in the amount of protein supplement fed during the trial.

Thus, while the results of the experiment discussed previously (as shown in Table 6 and Figure II) indicate that the protein needs of fattening steer calves for satisfactory gains are met from lower levels of protein supplement during the latter part of the feeding trial, it was not possible to obtain equal results when such a practice was followed in two trials.

Solvent vs. Hydraulic Cottonseed Meal in Rations for Fattening Steer Calves

A summary of the results of two fattening trials with steer calves full-fed corn, 1.0 pound of alfalfa hay, limited amounts of sorghum silage and 1.5 pounds per head daily of either pre-press solvent-extracted cottonseed meal or hydraulic-processed cottonseed meal is presented in Table 8. Chemical composition of the feeds used and feed prices are shown in Tables 9 and 10, Appendix.

Average daily gains were 2.23 and 2.17 pounds per steer for those fed hydraulic-processed and solvent-extracted cottonseed meals, respectively. The steers fed the solvent meal required 20 pounds more corn per hundredweight gain than those fed hydraulic-processed meal, and this resulted in \$.76 more feed cost per hundredweight gain under the prevailing feed prices. The net loss per steer was \$3.44 for the steers fed hydraulic-processed meal, as compared to \$13.44 for those fed solvent-extracted meal. Steers fed rations supplemented with hydraulic-processed meal produced one prime and 18 choice carcasses, as compared to three prime and 16 choice carcasses in the lot fed solvent-extracted meal. This was not consistent with their on-foot value, however, since steers fed hydraulic-processed meal had an appraised market value of \$.38 more per hundredweight than those fed solvent meal.

These trials indicate that the difference in average daily gain of steers fed the two differently processed meals corresponds very closely to the difference in the fat content of the two meals. In other words, the removal of about 0.09 pound of fat from the daily ration of the steers fed the solvent-extracted cottonseed meal, as compared to those fed hydraulic-processed meal, resulted in a decrease of 0.06 pound in average daily gains.

These results are in agreement with those obtained by investigators at the Texas station who fed the two differently processed meals in a fattening ration to yearling steers at levels of 4 pounds per head daily (Marion et al., 1950, 1951) and 2.57 pounds per head daily (Marion et al., 1952). It would appear that under conditions of maintenance, such as wintering steers on native range, the effect of different methods of processing may not be as important as it is in the feed lot where maximum performance is desired.

Table 8. Results Obtained in a Study of Hydraulic vs. Solvent-Processed Cottonseed Meal for Fattening Steer Calves.
(Average of two trials, 1951-53, 171 days on test.)

Lot No.	Lot 1	Lot 8 ¹
Method of Processing Cottonseed Meal Fed	Hydraulic-Processed	Pre-press Solvent-Extracted
Total number of steers	19 ²	19 ²
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
Alfalfa hay	1.00	1.00
Supplement	1.50	1.50
Silage	7.84	7.76
Salt	.03	.03
Mineral	.04	.04
Feed/cwt. gain		
Ground shelled corn	490	510
Alfalfa hay	45	46
Supplement	68	69
Silage	352	357
Feed cost/cwt. gain (dollars)	21.40	22.16
Financial results (dollars)		
Appraised value/cwt.	28.63	28.25
Total value/steer (3% shrink)	233.91	224.82
Initial cost	157.37	157.63
Feed cost/steer	79.98	80.63
Total cost/steer	237.35	238.26
Return/steer	-3.44	-13.44
Carcass grades		
U.S. Prime	1	3
U.S. Choice	18	16

¹ Referred to as Lot 8 in 1951-52 trial and Lot 4 in 1952-53 trial.

² One steer removed (1951-52) due to factors unrelated to ration fed and was not included in above data.

SUMMARY

A total of six fattening trials were conducted with steer calves fed a basic ration of ground shelled corn (full-fed), protein supplement, sorghum silage and a limited amount of alfalfa hay. In two trials, the ration was supplemented with 1.5, 1.0 or 0.5 pounds of cottonseed cake per head daily to determine the optimum level of protein supplement in fattening rations for steer calves. Steers fed 1.5 pounds of cottonseed cake per head daily made greater average daily gains ($P \leq .01$), required less feed per hundred-weight gain and had a higher appraised market value at the completion of the trial than those fed either 1.0 pound or 0.5 pound of cottonseed cake. Financial returns per steer and carcass grades followed the same trend. There was no significant difference in average daily gains of steers fed 1.0 pound or 0.5 pound of cottonseed cake, although the performance of steers fed the 1.0 pound level was more satisfactory than those fed 0.5 pound as regards average daily gain, efficiency of feed utilization and financial returns per steer. When the results of these trials were combined with two previous trials reported by Maynard (1950), a similar trend was observed.

Examination of the individual weight gains of steer calves fed different levels of protein supplement revealed that (a) the necessary amount of protein supplement in fattening rations of the type used in this study appears to depend somewhat on the initial weight of the calf, and (b) gains during the first half of the fattening period were directly proportional to the amount of protein supplement fed, while there appeared to be no

consistent effect of the different levels of protein supplement fed and gains made by the steers during the last part of the fattening period.

Two fattening trials were conducted to study the effect of gradually reducing the amount of protein supplement fed steer calves, as compared to feeding the same average amount throughout the trial. The results of these tests indicate that there is no advantage as far as average daily gains, efficiency of feed utilization or returns per steer are concerned from feeding more protein supplement during the early part of the trial, and less during the latter part, as compared to feeding the average amount throughout the trial.

The results of two trials, in which hydraulic and solvent-extracted cottonseed meals were compared as supplements to fattening rations for steer calves, showed that steers fed the hydraulic product made slightly greater average daily gains and required less feed per hundredweight gain than those fed solvent meal. The appraised market value at the end of the trial and the financial returns per steer likewise favored those fed the hydraulic meal.

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APPENDIX

Table 9. Chemical Composition of Feeds Used in Fattening Trials with Steer Calves.

	Percent Dry Matter	Percentage Composition of Dry Matter						Ca	P
		Ash	Protein	Fat	Crude fiber	N-free extract			
1948-49									
Corn	88.22	1.55	10.66	6.43	2.13	79.23	.04	.37	
Cottonseed cake	92.73	6.01	44.15	7.78	11.46	30.60	.24	.90	
Alfalfa hay	93.49	11.22	19.54	3.12	30.72	35.40	2.27	.14	
Sorghum silage	40.27	7.15	5.88	2.41	32.88	51.68	.34	.20	
1949-50									
Corn	87.43	1.71	11.33	5.55	2.22	79.19	.02	.33	
Cottonseed cake	93.67	5.93	43.61	6.07	12.49	31.90	.21	.78	
Alfalfa hay	89.68	7.52	16.63	2.72	34.81	38.32	1.07	.33	
Sorghum silage	32.00	9.22	5.81	2.19	25.19	57.59	.27	.24	
1950-51									
Corn	89.49	1.46	9.68	3.91	2.11	82.82	.05	.22	
Cottonseed cake	92.55	7.40	41.43	5.73	10.73	34.72	.22	1.01	
Alfalfa hay	91.27	7.99	13.49	2.25	43.09	33.19	.14	.18	
Sorghum silage	28.60	8.35	4.73	3.35	21.27	62.30	.48	.26	
1951-52									
Corn	88.61	1.64	10.12	4.40	2.06	81.78	.06	.32	
Cottonseed cake	93.13	7.24	43.35	8.21	11.40	26.79	.27	1.05	
Cottonseed meal (Solvent)	91.78	6.30	44.91	0.69	13.42	34.00	.26	.87	
Alfalfa hay	92.36	10.32	17.81	2.41	29.89	39.56	1.32	.18	
Sorghum silage	30.00	7.10	5.67	6.40	26.47	54.37	1.17	.47	
1952-53									
Corn	86.60	1.65	9.17	4.61	1.92	82.65	.07	.13	
Cottonseed meal (Hydraulic)	94.01	6.49	41.99	5.37	10.18	35.96	.19	.76	
Cottonseed meal (Solvent)	92.75	6.65	41.30	.57	12.90	38.59	.17	.70	
Alfalfa hay	91.06	11.44	17.54	1.26	33.69	37.39	1.00	.16	
Sorghum silage	32.94	15.82	4.31	3.55	26.56	47.75	.33	.30	

Table 10. Feed Prices Per Ton Used in Fattening Trials with Steer Calves.
(Dollars)

Year	1948-49	1949-50	1950-51	1951-52	1952-53
Corn	41.20	53.60	51.80	77.80	64.30
Cottonseed cake	100.00	86.00	77.50	81.00	
Cottonseed meal (Hydraulic)			77.50	80.00	106.00
Cottonseed meal (Solvent)				80.00	106.00
Alfalfa hay	22.00	20.00	17.50	25.00	30.00
Sorghum silage	6.00	6.00	5.00	6.00	10.00
Salt	16.80	10.40	13.60	15.00	15.00
Mineral mixture ¹	44.60	39.13	53.80	63.00	72.50

¹Mineral mixture fed free-choice consisted of equal parts of salt, ground limestone and steamed bone meal in 1948-52 trials, and a mixture of two parts salt and one part bone meal in the 1952-53 trial.

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