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COTTONSEED CAKE AS A PARTIAL SUBSTITUTE
FOR CORN FOR FATTENING
STEER CALVES IN DRY LOT

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PREFACE

Cotton is "King" of the South's cash crops. The 1937 farm value of this crop, according to the Department of Agriculture estimates, was \$784,106,000. Cotton may likewise be given the title of "King" of the feed crops, for it was the source of 2,031,500 tons of cottonseed cake and meal, a protein-rich feed, and 1,146,000 tons of cottonseed hulls.

Approximately seven percent of the farm land in Oklahoma was devoted to cotton in 1937. Oklahoma, which ranks sixth in acreage harvested and eighth in production of cotton among the cotton belt states, produced 825,000 bales of cotton and 367,000 tons of cottonseed in 1937. From this seed 129,048 tons of cottonseed cake and meal were crushed and made into available feed.

Cottonseed cake and meal have been used very extensively throughout the cotton belt and in a few of the western states as a protein supplement for cattle. Investigations have proved one hundred pounds of cottonseed cake, fed as a protein supplement, to be worth two or three times that amount of corn in fattening rations for cattle. Amounts in excess of that needed as a protein supplement have been fed with varying degrees of success. In a majority of the cases where cottonseed cake has been fed in large amounts, cottonseed hulls have been used as the sole roughage. This has often resulted in what is commonly known as "cottonseed meal poisoning", which has later been found to be a deficiency in the ration fed rather than the toxic effect of the cottonseed cake itself.

In the southern states cottonseed cake is often cheaper than corn and as the cattle feeder is constantly in search of a ration that will produce a maximum amount of beef at a minimum cost, it is only natural

for him to be interested in substituting cottonseed cake for all, or as much as possible, of the grain portion of rations for fattening cattle.

Our knowledge of animal nutrition as well as experimental results clearly indicates that there is an optimum amount of cottonseed cake that need be fed to cattle strictly as a protein supplement. Any additional protein supplied is of value only as a source of heat, energy, and fat for the animal body; therefore, it is of no greater value than the common grains as sources of heat, energy, and fat.

Realizing, therefore, that the partial or complete substitution of cottonseed cake for corn is a vital factor in the cattle feeding operations of the South and South Central parts of the United States, the Oklahoma Agricultural Experiment Station, as well as many other stations, has conducted numerous experiments to determine not only the value of cottonseed cake as a fattening concentrate, but also how it can be fed with safety over long periods of time.

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REVIEW OF LITERATURE

Snapp(26) reports that the feeding of 11.04 pounds of cottonseed meal, 2.01 pounds of alfalfa hay and 20 pounds of silage per head daily to yearling steers resulted in a daily gain of 2.39 pounds per head per day. The check lot receiving 10.04 pounds of corn, 1 pound of cottonseed meal, and like amounts of roughage made slightly larger daily gains and the cost per hundred pounds gain was \$1.26 less than the cottonseed lot. The cottonseed lot showed more finish and bloom than the yearlings receiving a basal ration of ground corn and outsold them by twenty-five cents per hundredweight. The cottonseed lot made the greatest daily gain, 3.44 pounds, in the last 20 days of the trial when they were receiving a daily ration of 14.18 pounds of cottonseed meal.

In an experiment to determine the advisability of adding corn to a ration of cottonseed meal and hulls, Jones et al. (11) found that the steers receiving only meal and hulls required a greater number of pounds of feed to produce a hundred pounds of gain, but utilized more roughage and less concentrates. With cottonseed meal and ground shelled corn costing about the same price pound for pound and hulls costing about one-fourth as much, the cost of one hundred pounds of gain was less where only meal and hulls were fed. The corn lot sold for \$0.84 more per hundredweight than did the cottonseed lot due to the higher degree of finish obtained. Faint indications of cottonseed meal poisoning were evident at the end of the experiment in the lot which was fed on meal and hulls alone. This would indicate that a ration consisting entirely of cottonseed meal and cottonseed hulls should not be fed for more than a 90 to 100 day feeding period.

In a summary of four trials with yearling and two-year-old grade

Hereford, Angus and Shorthorn steers, Barnett and Goodell (2) found that the feeding of a limited ration of 5.44 pounds of cottonseed meal and all the corn silage the steers would consume did not result in as large daily gains as did the feeding of corn, cottonseed meal and corn silage full-fed. However, the steers fed a limited ration of cottonseed meal produced 100 pounds of gain with a saving of 369 pounds of concentrates, but required an additional 1243 pounds of roughage over that required by similar steers fed a ration of corn, cottonseed meal and corn silage full-fed.

Edwards and Massey (7) made a study of the different proportions of corn and cottonseed meal for fattening steers. Their results indicate that the heavier rate of cottonseed meal feeding produced as good gains as the lighter rates for the first twelve weeks of test, but that the heavier rate does not give equal results after that time. The steers receiving the heaviest ration of cottonseed meal were the least profitable, but made practically the same daily gain.

Grimes et al. (10) in a six year study of feeding an average of 4.69 pounds of cottonseed meal as a supplement for steers on blue grass pasture found that they made an average daily gain of 2.47 pounds per steer per day as compared to 1.92 pounds per steer per day on pasture alone. With cottonseed meal at \$20.00 per ton the cost of 100 pounds of gain for the steers receiving cottonseed meal on pasture was \$2.65. When grass-fat cattle are worth \$5.00 per hundredweight then cottonseed meal is worth \$38.75 per ton.

In a summary of three years' work, the New Mexico Station (20) found that yearling steers fed an average of 9.51 pounds of cottonseed meal per head per day made slightly larger daily gains and required less

grain to produce one hundred pounds of gain than did similar cattle fed an average daily ration of 6.84 pounds of ground kafir and 2.34 pounds of cottonseed meal per steer.

Barnett and Goodell (1) in a feeding trial of cottonseed meal and cottonseed meal and varying proportions of corn found that where cottonseed meal was the sole concentrate fed with silage the daily gains were not as high as the lots receiving corn in addition to cottonseed meal.

In an 120 day feeding trial Skinner and Cochel (25) found that the addition of cottonseed meal to a ration of shelled corn and clover hay, resulted in more rapid and cheaper gains, higher finish, and greater profit per steer.

Gayle (8) reports that the exclusive use of cottonseed meal as a concentrate for calves has invariably resulted in large daily gains, and very economical gains. The calves have tended to grow more and fatten less than was desirable. The calves receiving corn required more than twice as much grain to produce one hundred pounds of gain, but somewhat less alfalfa hay and only a little more than half as much silage. This resulted in more expensive gains for the calves receiving corn.

In a four year average of feeding cottonseed meal and corn in varying amounts Blizzard (5) found that the replacing of 1.76 pounds of corn with 2.07 pounds of cottonseed meal maintained the same rate of gain, but increased the concentrates required to produce one hundred pounds gain by 3 percent and the roughage requirement by 2.36 percent. This study also showed that the feeding of 1.5 pounds of 43 percent cottonseed meal will supply the needed protein in a ration of ground shelled corn, prairie hay, and ground limestone, but the feeding of 2.5 pounds of cottonseed meal per head per day will produce a slightly better coat

of hair, more bloom on the cattle, and may add to the selling price.

Blizzard concludes that:

"Forty-three percent cottonseed meal can profitably be substituted for corn when the cost of sixty-six pounds of cottonseed meal is equivalent to the cost of a bushel of corn."

Knox (12) in an 168 day feeding trial found that the use of large amounts of cottonseed meal did neither increase the shrink of the steers en route to market, nor decrease the dressing percentages or carcass grades of the cattle. In this study the steers were fed an average of 8.28 pounds of cottonseed meal daily per steer. The carcass yield was 61.54 percent with 6 choice and 4 good carcasses in the lot.

In an experiment to determine the value of cottonseed meal as a protein supplement in fattening two-year-old steers, Skinner and Cochel (24) found that the addition of cottonseed meal did not decrease the total amount of other feeds consumed, but seemed to stimulate the appetite of the steers to such an extent as to increase the daily feed consumed practically three pounds per head. In this trial 1.16 pounds of cottonseed meal replaced 1.55 pounds of shelled corn, .63 pound clover hay and 2.26 pounds of corn silage in producing one pound of gain. The necessary selling price for the cattle receiving the supplement was four cents per hundred pounds greater than those fed no supplement, while the actual market value was thirty cents per hundred pounds in favor of the lot fed a supplement in addition to a ration of shelled corn, clover hay, and corn silage.

In a study to determine the amount of cottonseed meal that is advisable in feeding calves, Blizzard (3) found that the feeding of 2.77 pounds of cottonseed meal per head per day in a ration of corn, cottonseed meal, alfalfa hay and ground limestone, resulted in slightly larger daily gains and a saving of 45 pounds of concentrates per hundred

pounds of gain over the requirement of calves fed a similar ration, but 2.01 pounds of cottonseed meal. The steers fed the greater amount of cottonseed meal sold for \$0.75 per hundredweight higher than those fed the smaller amount. A third lot of calves which received a similar ration, but only 1.28 pounds of cottonseed meal, required even less feed per hundred pounds gain than did those calves receiving either 2.77 or 2.01 pounds of cottonseed meal per head per day. The cost of producing one hundred pounds gain was \$0.65 less in the third than in the first lot, but both lots sold for the same price per hundredweight.

The New Mexico Station (19) fed one lot of steers an average of 10.31 pounds of cottonseed meal daily per steer. A similar lot of steers was fed small amounts of cottonseed meal for the first eighty-four days and full-fed the last eighty-four days. These steers received an average of 7.03 pounds of cottonseed meal per head per day. The lot that was full-fed the entire feeding period made slightly larger gains, produced one hundred pounds gain on less feed and therefore returned a greater net profit per head.

The steers full-fed the entire trial sold for 40 cents more per hundredweight and dressed 63.21 percent as compared to 61.73 percent for the lot which was full-fed only the latter 84 days of the trial.

Skinner and King (23) in experimenting with big steers found that the feeding of cottonseed meal reduced the amount of grain and roughage required to produce one hundred pounds gain, but did not reduce the total feed required per unit of gain.

In a study of a limited grain ration as compared to full feeding steers, Skinner and King (22) found that a limited corn ration plus 2.44 pounds of cottonseed meal produced slightly smaller daily gains

than were produced by cattle receiving a full feed of corn. However, the lot on a limited grain ration made more economical gains, and although they were valued \$0.10 per hundred pounds less, returned a profit of \$1.86 per steer over the steers fed the "all-corn" ration.

Blizzard (4) in a study of the advisability of feeding different amounts of cottonseed meal for fattening calves found that one lot of steers which received .58 pound of cottonseed meal and slightly more corn than did Lot II which received 2.31 pounds of cottonseed meal produced slightly larger daily gains at a lower cost per hundred pounds gain. The heavier feed of cottonseed meal did not show any advantage in substituting meal for corn above the .58 pound level when fed with corn and alfalfa hay. Feed prices used were, corn 32 cents per bushel, cottonseed meal \$15.50 per ton, and alfalfa hay \$11.00 per ton.

McC Campbell and Horlacher (15) working with high grade Hereford calves conducted an experiment to determine the amount of cottonseed meal that the feeder can most economically add to a ration of shelled corn, cane silage, and alfalfa hay. Each lot received the same basal ration of shelled corn and cane silage, both full fed, and two pounds of alfalfa hay per head per day. In addition they were fed cottonseed meal in varying amounts.

The calves receiving one pound of cottonseed meal made greater gains at a smaller unit cost than did the calves receiving either .5 pound or 1.16 pounds of cottonseed meal per head per day. A fourth lot receiving two pounds of cottonseed meal per steer daily made slightly larger daily gains, but the cost per one hundred pounds gain was considerably higher.

In repeating the above experiment McC Campbell et al. (16) found that in an 165 day feeding period the calves receiving .90 pound of cotton-

seed meal made slightly larger daily gains at a lower cost per hundred pounds gain than did calves receiving 1.69 pounds of cottonseed meal per head per day.

These experiments also show that the cost of gain alone does not determine the profit in feeding cattle. Cattle fed the cheaper of two rations may or may not make the greater profit. The gains of the cattle fed one pound of cottonseed meal in addition to corn, silage, and alfalfa hay cost more than did the gains of cattle fed corn, silage, and alfalfa hay; yet, the cattle receiving the cottonseed meal made a greater profit than the cattle receiving only corn, silage, and alfalfa hay because they developed more finish and sold for enough more per hundred pounds to pay for extra feed cost and still leave a margin of \$0.16 per hundred pounds.

In a study to determine the efficiency of various amounts of cottonseed meal to supplement a ration of ground corn, ground barley, wet beet pulp, and alfalfa hay, Osland et al. (21) considered one-half pound of cottonseed cake daily as 100 percent efficient. An average of two years' work shows that an extra half pound of cake is only 36.21 percent as efficient, and each additional pound, above one-half pound daily, is only 27.94 percent as valuable. This experiment indicated that one-half pound of cottonseed cake is sufficient for most economical gains and balances a standard beet by-product ration for fattening calves.

McCampbell (14) found that one pound of ground wheat was worth 53 percent, one pound of ground barley 52 percent, one pound of ground kafir 46.5 percent, and one pound of ground milo 45 percent as much as one pound of 43 percent cottonseed cake when used as supplements to atlas sorgo silage.

Lantow (13) in studying supplemental feeds for wintering dry cows and weaned calves found that cottonseed cake showed an advantage over ground yellow corn. The advantage was shown in weight gain, being greater with cows than with weaned calves. Cottonseed cake also proved more palatable than ground corn. He observed that,

"When the cattle are fed in groups, cottonseed cake lends itself better than ground corn to fairly uniform individual consumption."

Gerlaugh (9) found that the addition of one pound of cottonseed meal to rations for calves being full fed on corn while running on blue grass pasture did not increase the daily gains, but did increase the cost of a hundred pounds gain. There was a slight difference in the finish of the two lots in favor of the lot fed cottonseed meal.

Briggs (6) found that .10 pound of cottonseed meal in a lamb fattening ration had a productive value of approximately 122 percent that of shelled corn. When fed in larger amounts the cottonseed meal had a lower value. When fed at the rate of .73 pound per lamb daily, the 43 percent meal fed had an average value of 90 percent that of corn.

A summary of the results obtained from feeding cottonseed cake in various quantities and combinations in table form follows as Table I. The listings are in order of amounts fed.

Table I

RESULTS OBTAINED FROM FEEDING COTTONSEED CAKE AND MEAL IN VARIOUS QUANTITIES

Station	Reference Number	Initial Weight	Number Days Fed	Daily Gains	Concentrates	C.S.C. or C.S.M. Per Day	Roughage
Snapp	(28)	546	140	2.39		11.04	Silage and alfalfa hay
New Mexico	(19)	783	168	2.41		10.31	Silage and alfalfa hay
New Mexico	(20)	778	168	2.52		9.92	Silage and alfalfa hay
New Mexico	(12)	690	168	2.10		8.28	Silage and alfalfa hay
New Mexico	(19)	793	168	2.41		7.03	Silage and alfalfa hay
Texas	(11)	834	120	2.41	Corn	6.17	Cottonseed hulls
Mississippi	(2)	775	122	2.00		5.44	Silage
Georgia	(7)	460	140	2.00	Corn	4.94	Cowpea hay
Alabama	(10)	600	84	2.47		4.69	Blue grass pasture
Mississippi	(1)	811	112	2.44	Corn	4.03	Corn silage
Indiana	(25)	1140	120	2.67	Corn	3.97	Clover hay
Mississippi	(8)	430	156	1.74		3.69	Silage and alfalfa hay
Oklahoma	(5)	396	173	2.09		3.52	Silage and prairie hay
Indiana	(24)	1010	180	2.57	Corn	2.99	Silage and clover hay
Oklahoma	(3)	309	200	1.98	Corn	2.77	Alfalfa hay
Indiana	(23)	851	150	2.16	Corn	2.60	Silage and clover hay
Indiana	(22)	876	150	2.02	Corn	2.45	Silage and clover hay
Indiana	(23)	688	150	2.09	Corn	2.38	Silage and clover hay
Oklahoma	(4)	362	169	1.76	Corn	2.31	Alfalfa hay
Kansas	(15)	349	231	2.12	Corn	1.92	Silage and alfalfa hay
Kansas	(16)	415	165	2.10	Corn	1.69	Silage and alfalfa hay
Colorado	(21)	397	192	2.14	Corn and barley	1.40	Beet pulp and alfalfa hay
Kansas	(14)	431	150	.86		1.00	Silage
New Mexico	(13)	(Cows)	84	.68		1.00	Pasture supplement
Ohio	(9)	460	182	1.67	Corn	1.00	Pasture
New Mexico	(13)	(Calves)	84	.29		.50	Pasture
Oklahoma	(4)	363	169	1.81	Corn	.15	Alfalfa hay

EXPERIMENTAL

Duration of the Experiments

Two years of experimental work are included in this study, 1937 - 1938 and 1938 - 1939. The 1938 trial started with the p.m. feed on November 17, 1937 and continued until after the a.m. feed on April 20, 1938, a period of 154 days. The 1939 trial started with the p.m. feed on November 8, 1938 and continued until after the a.m. feed on April 19, 1939, a period of 162 days.

Object of the Experiments

The object of these experiments was to find the replacement value of forty-three percent cottonseed cake fed as a substitute for corn in fattening rations for steer calves in dry lot.

Feeds Used and Method of Feeding

- Lot 1. Ground shelled corn full-fed, cottonseed cake two pounds, silage full-fed, and ground limestone one-tenth pound.
- Lot 2. Ground shelled corn ($\frac{1}{2}$ of lot 1), cottonseed cake full-fed, silage and ground limestone same as lot 1.
- Lot 3. Ground shelled corn full-fed, cottonseed cake two pounds, silage full-fed and ground limestone one-tenth pound.
- Lot 4. Ground shelled corn ($\frac{1}{2}$ of lot 3), cottonseed cake two pounds, silage and ground limestone same as lot 3.

The plan of the two experiments called for the feeding of identical amounts of silage and ground limestone to both lots of the same series.

Corn was fed ad lib. in the check lots; whereas, exactly one-half of that amount of corn was given the test lot and cottonseed cake was allowed ad lib. with this half ration of corn. Cottonseed cake was fed as a protein supplement in the check lots. Lot 1 received 2 pounds per head daily and lot 3 received 1.95 pounds per head daily.

The steers were hand-fed grain twice daily at 6:00 a.m. and 5:00 p.m. Silage was fed three times daily; after each grain feed and again at noon. The steers had free access to common salt and a mineral mixture of equal parts steamed bone meal, ground limestone, and common salt.

Cattle Used

Each year sixteen high grade Hereford steer calves purchased from the E. C. Mullendore ranch in Osage County, Oklahoma were used in these experiments.

Both groups of calves were of choice quality. They were approximately six months of age when purchased at weaning time. These calves were sired by Registered Hereford bulls and out of good grade cows.

The steers in the 1938 experiment were dehorned with a saw on December 16, 1937. The steers in the 1939 experiment were dehorned with a hot iron when they were small calves, but five of them had to be dehorned again at the start of the experiment in order to have all lots uniform.

After fully recovering from the effects of weaning and shipping the steers were divided into lots of eight steers each according to their weight, quality and indications of possible outcome. Leather neck straps with metal numbers were used as a means of identification.

Weights of Animals

Individual weights were taken on three consecutive days and an average of these weights taken as the initial weight. Individual weights were taken every twenty-eight days thereafter until the final twenty-eight day period when individual weights were again taken on three consecutive days and an average of these weights taken as the final weight. The steers were weighed at approximately the same time each weigh day.

Housing and Yards

The steers were penned in identical paved feeding lots. The lots were thirty feet square, and were enclosed on the north by a shed twenty-four feet deep. In 1938 wheat straw was used for bedding in the shed which had a dirt floor.

All feeds were fed in identical movable feed bunks located under the shed. Each lot was also equipped with a stationary water tank.

Description of Feeds

The shelled corn was coarsely ground in a ten inch John Deere Hammer-Mill, not because experimental data indicated it should be ground, but to facilitate mixing with other grains studied in the same experiment. The corn was graded No. 1 and weighed 55 pounds per bushel.

The silage fed was made from atlas sorgo. The silage used in the 1938 experiment was from drought damaged sorgo that contained practically no grain, whereas the silage used in the 1939 experiment was normal and contained quite a large proportion of grain; however, both crops

were of good color and palatability. The silage used in 1938 had a carotene content of 4.8 parts per million and the silage used in 1939 contained 11.1 parts per million of carotene.

Table II
CHEMICAL ANALYSES OF FEEDS

1938 Experiment

Percentage of:	H ₂ O	Protein	Ash	Fat	Fiber	N.F.E.
Ground shelled corn (No. 2)	12.79	10.11	1.41	3.89	1.98	69.82
Cottonseed cake (43%)	7.73	42.88	5.19	4.89	11.09	28.22
Grain sorghum silage*	71.50	2.64	2.45	.49	6.70	15.33

* The silage used had a carotene content of 4.8 parts per million.

1939 Experiment

Percentage of:	H ₂ O	Protein	Ash	Fat	Fiber	N.F.E.
Ground shelled corn (No. 1)	11.1	9.95	1.23	3.87	1.68	72.17
Cottonseed cake (43%)	8.43	42.23	6.39	6.24	9.46	27.02
Grain sorghum silage*	76.17	1.73	1.51	.76	5.51	14.27

* The silage used had a carotene content of 11.1 parts per million.

Table III
SUMMARY OF 1938 - 1939 EXPERIMENTS

Lot number*	1	2	3	4
Number of steers per lot	8	8	8	8
Initial weight per steer	Pounds 466.00	Pounds 466.00	Pounds 446.00	Pounds 445.00
Final weight per steer	767.00	775.00	835.00	841.00
Average daily gain per steer	1.95	2.00	2.40	2.44
Average daily ration:				
Ground shelled corn	9.15	4.57	10.28	5.14
Cottonseed cake (protein supplement)	2.00	2.00	1.95	1.95
Cottonseed cake (substitute for corn)		4.37		5.07
Silage	10.71	10.80	12.44	12.44
Ground limestone	.10	.10	.10	.10
Maximum daily consumption per steer:				
(Concentrates)				
Ground shelled corn	13.50	6.75	16.00	8.00
Cottonseed cake	2.00	9.00	2.00	10.50
Nutritive ratio**	1:6.35	1:2.89	1:6.79	1:2.96
Total net energy**	10.44	10.08	10.79	11.37
Feed required per 100 lbs. gain:	Pounds	Pounds	Pounds	Pounds
Ground shelled corn	469.23	228.50	428.33	210.66
Cottonseed cake	102.56	318.50	81.25	287.70
Silage	549.23	540.00	518.33	509.84

* Lots 1 and 2 are from the 1938 Experiment, 3 and 4 from 1939.

** Calculated from (17).

Observations of Table III

1. All lots made very satisfactory gains. The smallest gain was made in lot 1 with an average daily gain of 1.95 pounds per steer. This lot received an average daily ration of 9.15 pounds ground shelled corn, 2.00 pounds cottonseed cake, 10.71 pounds silage, and .10 pound of ground limestone. The highest gain was made in lot 4 with an average daily gain of 2.44 pounds per steer. This lot received an average daily ration of 5.14 pounds of ground shelled corn, 7.02 pounds of cottonseed cake, 12.44 pounds of silage and .10 pound of ground limestone per steer.

2. The lots receiving cottonseed cake as a partial substitute for corn did not seem to tire of the ration. The maximum daily consumption of cottonseed cake was 10.5 pounds per steer per day. At the close of the experiment these steers were consuming eight pounds of cottonseed cake daily per steer.

3. There were no apparent indications of so-called "cottonseed meal poisoning" at any time during either experiment.

4. Lot 4 made the largest daily gain of any of the lots, and required the smallest amount of feed to produce 100 pounds of gain. In this lot 498 pounds of concentrates and 510 pounds of silage fully replaced 510 pounds of concentrates and 518 pounds of silage required to produce 100 pounds of gain in lot 3, or a saving of 12 pounds of concentrates and 8 pounds of silage.

5. Lot 2 made very satisfactory gains. This lot of steers produced 100 pounds of gain on 547 pounds of concentrates and 540 pounds of silage as compared to 572 pounds of concentrates and 549 pounds of silage for the check lot, or a saving of 32 pounds of concentrates and

9 pounds of silage in favor of the lot receiving cottonseed cake as a substitute for half the corn consumed by the check lot.

6. The nutritive ratios of the rations containing large amounts of cottonseed cake were very narrow as compared to the standard range of 1:6.6-7.1 as recommended by Morrison (17). The check rations fed lots 1 and 3 had nutritive ratios of 1:6.35 and 1:6.79 respectively; whereas, the test rations fed lots 2 and 4 had nutritive ratios of 1:2.89 and 1:2.96 respectively.

7. The amount of cottonseed cake fed as protein supplement in lots 1 and 3 was deducted from the total amounts consumed in lots 2 and 4 to determine the amount that was actually fed as a substitute for corn.

Table IV
AVERAGE DAILY GAIN PER STEER BY LOTS
TWENTY-EIGHT DAY PERIODS

	Lot 1	Lot 2	Lot 3	Lot 4
	Average	Average	Average	Average
	Daily Gain	Daily Gain	Daily Gain	Daily Gain
	Pounds	Pounds	Pounds	Pounds
First 28 day period	2.07	2.00	2.40	2.58
Second 28 day period	1.05	1.03	2.37	2.30
Third 28 day period	2.25	2.57	2.28	2.28
Fourth 28 day period	2.12	2.29	2.68	2.50
Fifth 28 day period	2.48	2.70	2.50	2.50
Final period	1.55	.82	2.12	2.51
Average	1.95	2.00	2.40	2.44

Observation of Table IV

1. Table IV shows the average daily gains of the lots of steers by twenty-eight day periods. It should be noticed that in most cases the gains of the two lots of a series were consistent, that is, they both either went "up" or "down" together; however, there are two exceptions to this, both occurring in the final period. The gains of lots 1 and 2 dropped considerably in the final period, lot 2 (cottonseed cake lot) dropping the most; whereas, the gains of lots 3 and 4 also dropped a slight amount, but in this case lot 3 (corn lot) dropped the most.

Table V

MARKETING DATA

Lot number	1	2	3	4
Experimental year	1938	1938	1939	1939
Shrink*	20.00 lbs.	13.00 lbs.	28.75 lbs.	15.00 lbs.
Dressing Percentage	59.50	57.00	59.60	59.50
Carcass grades	Not Available	Not Available	8 - Choice Carcasses	6 - Choice and 2 - Good Carcasses

* Shrink is calculated from closing weights of the experiment and selling weights at Oklahoma City.

Observations of Table V

1. In both cases the lots that received a large allowance of cottonseed cake shrunk less than the check lots en route to market. The steers from lots 1 and 3, the check lots shrunk 20.00 and 28.75 pounds respectively; whereas, those from lots 2 and 4, the cottonseed cake lots, shrunk only 13.00 and 15.00 pounds respectively. It was

observed that the steers from the cottonseed cake lots consumed larger quantities of prairie hay and water upon arrival at the stock yards.

2. Each year the steers fed corn yielded a higher percentage of carcass than did the lot fed cottonseed cake in the same trial. Lot 1 yielded 59.50 as compared to 57.00 percent for lot 2, and lot 3 yielded 59.60 percent as compared to 59.50 percent for lot 4.

3. Carcass grades made by Wilson & Co. reveal a slight advantage in average grade rank for the steers fed corn. The carcasses from the 1939 experiment were examined by Professor Bruce R. Taylor of the Animal Husbandry Department. His comment follows:

"The steers from lot 3, the corn lot, showed desirable creamy white fat of satisfactory thickness and uniform covering. They were satisfactory in kidney fat and were well covered over the rounds and loins. The carcasses from lot 4, the cottonseed cake lot, all showed an extremely dead white slightly flaky fat that was fired to a noticeable but not objectionable degree. The inside covering and kidney fat was greater in these carcasses than in those of the corn-fed group. The covering over the rounds and loins was deficient as compared to the carcass from the corn-fed steers. There were no dark-cutting carcasses in either lot."

Table VI

FINANCIAL STATEMENT OF 1938 - 1939 EXPERIMENTS *

Lot number	1	2	3	4
Number of steers per lot	8	8	8	8
Initial weight per steer	Pounds 466.00	Pounds 466.00	Pounds 446.00	Pounds 445.00
Final weight per steer	767.00	775.00	835.00	841.00
Total gain per steer	301.00	309.00	389.00	396.00
Cost of feed per 100 lbs. gain	7.21	7.21	5.78	6.50
Initial cost per steer	Lots 1 and 2 @ \$9.00 per cwt.		Lots 3 and 4 @ \$8.50 per cwt.	
Feed cost per steer	41.94	41.94	37.91	37.83
Marketing cost per steer	21.70	22.28	22.49	25.74
Steer cost plus feed cost plus marketing cost	2.11	2.12	2.19	2.20
Necessary selling price per cwt. to cover steer cost plus feed cost	65.75	66.34	62.59	65.77
Selling price per cwt. (Oklahoma City)	8.30	8.29	7.23	7.56
Actual selling price per steer	8.75	9.10	11.00	10.35
Profit per steer	67.11	70.53	88.69	85.52
	1.36	4.19	26.10	19.75

* Feed prices used:

Corn
Cottonseed cake
Silage

1938
\$.60 per bu.
24.00 per ton
3.50 per ton

1939
\$.50 per bu.
26.00 per ton
3.50 per ton

Observations of Table VI

1. The feed costs per hundred pounds gain were identical in lots 1 and 2. A comparison of these two lots shows that the lot receiving the large allowance of cottonseed cake made slightly larger daily gains than did the check lot, and for this reason returned a greater profit per steer.

2. The feed cost per hundred pounds gain of lot 4 was \$0.72 greater than that of lot 3. Although the steers fed a large allowance of cottonseed cake made slightly larger daily gains and produced one hundred pounds of gain on less feed than did similar steers fed corn, the price of cottonseed cake was higher and the price of corn cheaper than it was for the previous year.

3. Interpretations based upon financial returns alone are of little value and may be misleading, as it is improbable that the prices of feed and cattle used in this experiment would be duplicated in future years.

Interpretations

This study involves two years of experimental work. The same basal feeds were used both years; however, the amounts fed differed by years. Snedecor's (27) method of analysis of variance was applied to determine statistically the significance of the differences in the rate of daily gain between the check lot and the test lot of the two experiments. The 1938 experiment is represented by lots 1 and 2. Applying the above method of analysis of variance, the standard error of the mean difference was found to be 0.164 pound. In order to be significant this difference in rate of daily gain should be 1.71 times the standard error of the mean difference. Lots 3 and 4 are from the 1939 experiment. The standard error of the mean difference was found to be 0.167 pound for these two lots; hence, in order to be significant this difference in rate of daily gain should be 1.68 times the standard error of the mean difference.

The mean difference in the rate of daily gain for lots 1 and 2 was 0.05 pound, and for lots 3 and 4 it was 0.04 pound. In order to be significant these differences in rate of daily gain should have been 0.28 pound; hence, there is no significant difference in the rate of daily gain between the check lot and the test lot of either experiment. Therefore, since each lot received like amounts of all feeds except those compared, we can determine from Table III just how much of the experimental or test grain (cottonseed cake) has been required to replace each one hundred pounds of corn in the check lot.

Morrison (18) has suggested that in experiments of this kind interpretations may be made by the application of net energy values to

the amounts of the different feeds the test concentrate replaced. Thus, by dividing this figure for "total net energy value replaced" by the total amount of test concentrate fed you obtain a net energy value for the test feed. This figure can then be compared with net energy values for corn, which have been determined by Morrison (17) and others.

A comparison of lots 1 and 2, according to the above mentioned plan, shows that the 43 percent cottonseed cake fed had a net energy value of 88.98 therms, as compared to 79.2 therms for No. 2 dent corn as given by Morrison (17). This gives 43 percent cottonseed cake a relative value per pound of 112.35 percent that of No. 2 dent corn. Comparing lots 3 and 4, where No. 1 dent corn was fed, the 43 percent cottonseed cake fed had a net energy value of 86.17 therms as compared to 81.1 therms for No. 1 dent corn, as given by Morrison (17). In this case 43 percent cottonseed cake had a relative value of 106.25 percent that of No. 1 dent corn per pound. It should be remembered that these values were obtained from the feeding of 43 percent cottonseed cake as a partial and not as a complete substitute for corn.

Discussion

The results obtained from these experiments substantiate and explain the earlier unexplained results secured by Kansas (27), and Oklahoma (4), in which large quantities of cottonseed cake proved to have materially higher values than most investigators had obtained. The findings also verify the opinion of present day authorities that cottonseed cake can successfully be fed in large amounts when the ration fed contains an adequate supply of vitamin A.

The relatively high value of 43 percent cottonseed cake to corn cannot be readily explained in the light of our present day knowledge of animal nutrition and present available information of the two feeds. The two years work are in close agreement. However, a third year's work should be completed before any conclusive results are published and a specific value given for cottonseed cake. It should be recognized that no other station has fed cottonseed cake in just the same manner as this, namely, the substitution of cottonseed cake for one-half the corn portion in a ration containing adequate amounts of vitamin A and calcium.

The southern cattle feeder realizing that he cannot always depend upon a corn crop, is vitally interested in knowing the relative value of cottonseed cake to corn in fattening rations for cattle and how it can be fed with safety. This study specifically answers these questions.

It should be recognized; however, that some packer buyers believe that steers fed large allowances of cottonseed cake yield "fired" carcasses and that proof of this fact might, at some future date, lead to packer discrimination of "heavy cake-fed steers" of market-topping finish if they become numerous on the market. This study has drawn attention

to this point, but has neither proved nor disproved the question.

CONCLUSIONS

1. Cottonseed cake proved to have a value of 112.35 percent that of No. 2 dent corn (yellow) as shown by the 1938 experiment; whereas, the 1939 experiment proved this value to be 106.25 percent that of No. 1 dent corn (yellow).

2. Forty-three percent cottonseed cake can economically be fed as a substitute for at least fifty percent of the corn in a calf fattening ration when the price of one pound of cake is equal to or cheaper than one pound of corn.

3. Forty-three percent cottonseed cake can safely be fed as one-half the grain portion of a fattening ration of ground shelled yellow corn, cottonseed cake, green colored atlas sorgo silage and ground limestone for at least 162 days.

4. Cottonseed cake proved to be slightly less palatable than corn when fed as a substitute for approximately one-half of the corn ration. There was no evidence that the steers became tired of cottonseed cake any more than they did of corn.

5. The feeding of cottonseed cake as a partial substitute for corn in fattening rations for steer calves proved to be satisfactory from the standpoint of rate of gain, feed required per unit of gain, selling price, and shrink en route to market.

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