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# Comparison of methods of full-feeding yearling steers

Edward W. Sanders

To the Graduate Council:

I am submitting herewith a thesis written by Edward W. Sanders entitled "Comparison of methods of full-feeding yearling steers." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Husbandry.

Charles S. Hobbs, Major Professor

We have read this thesis and recommend its acceptance:

O. G. Hall, H. J. Smith

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

June 28, 1962

To the Graduate Council:

I am submitting herewith a thesis written by Edward W. Sanders entitled "Comparison of Methods of Full-feeding Yearling Steers." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Husbandry.

Charles S. Hobbs
Major Professor

We have read this thesis
and recommend its acceptance:

O. Glen Hall

Harold J. Smith

Accepted for the Council:

Hilton A. Smith
Dean of the Graduate School

# COMPARISON OF METHODS OF FULL-FEEDING YEARLING STEERS

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A Thesis

Presented to

the Graduate Council of

The University of Tennessee

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In Partial Fulfillment

of the Requirements for the Degree

Master of Science

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by

Edward W. Sanders

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# CHAPTER I

## INTRODUCTION

Packers are demanding finished cattle that grade Good and Choice and meet certain carcass specifications. This requires that more cattle be full-fed. This program can easily be planned by the Southeastern area farmer who is able to make optimum use of pasture and roughage with a limited full-feeding period to meet the packer and consumer demand.

With the constantly increasing costs to farmers, efficient methods of feeding must be developed. Part-time farmers and farmers who finish cattle as a secondary source of income need an efficient feeding method that takes less regularity than the hand feeding method. Further, there is a trend in the Southeast toward more use of shelled corn due to picker-sheller combines and low relative cost of transportation of shelled corn from the Midwest by barge. Some feed processing plants have been equipped to prepare and deliver mixed feeds to the feeder. This gives the cattle feeder an opportunity to self-feed cattle without becoming involved in processing or handling any feed.

In commercial feedlots, labor, feed efficiency, and disease are major factors in determining profit and loss. With improved cow-calf herds for the production of feeder cattle, Tennessee and the Southeast have become a good location for feedlot operations.

The feeding experiments described in this thesis were designed to compare the results of finishing yearling steers in dry-lot by two methods of hand full-feeding and two methods of self-feeding.

## CHAPTER II

## REVIEW OF LITERATURE

In the early 1900's Mumford and Allison (1909) studied the need for a more efficient method of feeding steers for short periods (60-100 days). Working with 1000 pound three-year-old steers, they compared self-feeding and feeding twice a day for a 98-day feeding period. The self-fed mixed ration was a mixture containing ground corn, chopped hay and linseed meal. These workers stated that the cattle were on full feed in four weeks. Average daily gains were 2.98 pounds and 3.33 pounds for hand feeding and self-feeding, respectively. They concluded that self-feeding was cheaper even when hay chopping costs were included, that self-fed cattle consumed more feed and that a less experienced feeder was required.

Fuller et al. (1931) compared once a day, twice a day and self-feeding beef steers. They reported average daily gains of 2.72, 2.79 and 2.80 pounds, respectively for a 168-day feeding period. The feed cost per hundred pounds gained was lowest ($10.95) for twice a day feeding and was highest ($11.95) for self-feeding. In this investigation the corn was the only part of the ration self-fed. Duncan and Hazelwood (1945) concluded that feeding steers once a day was as satisfactory as feeding them twice daily based on daily gains of 1.80 and 1.85 pounds, respectively.

Working with 400-500 pound calves, Taylor et al. (1942) found

no advantage for self-feeding, as compared to hand feeding methods, except a small saving in labor. They found that calves could be put directly on self-feeders containing a mixture of corn and oats, even though the calves had never had grain before. Also, working with calves, Trowbridge et al. (1932) found very little difference in hand feeding and self-feeding as measured by daily gains.

Vaughan (1927) reported that beef calves self-fed gained 2.26 pounds per head daily as compared to 2.32 pounds per head daily for comparable calves fed twice daily. The calves weighed 450 pounds at the start of the experiment, and they were fed to a weight of 950 pounds. The gains cost more for the self-fed cattle, but they sold higher than the cattle fed twice daily; therefore, the self-fed cattle returned $1.50 more profit per head. Labor costs were not included in this report, but the author stated that the self-feeder can be used to save labor.

Using a ration of 74 per cent ground corn, 25 per cent ground cobs, 10 per cent soybean oil meal and 1 per cent alfalfa meal Mohrman et al. (1959) compared twice a day feeding, feeding six times a day by machine and self-feeding beef steers. The average daily gains for a 84-day period were 1.75, 1.95 and 1.99 pounds and the feed required for each pound gained was 10.6, 10.0 and 10.7 pounds for twice a day, six times a day and self-feeding, respectively. In a separate, reversible digestion trial, frequent feeding (four times daily) significantly increased the digestibility of nitrogen and energy ($P < .01$) as compared to feeding once daily.

Beeson et al. (1957) found that self-feeding increased daily gain and feed efficiency. Thus, steers self-fed required 9.86 pounds of feed per pound gain as compared to 11.65 pounds for hand-fed steers. Ear corn and Purdue Supplement A were used for the ration and hay was not fed after the first 28 days. These workers found that self-feeding increased dressing percentage by 1 per cent. Where the grain and protein supplement were fed free choice separately, the cattle consumed more protein than needed. In this trial, steers directly from pasture where they had been receiving 8 pounds of concentrate per day were turned in on the filled feed bunks without a transitional period. There were no ill effects from this method according to these workers.

In a recent extensive study by Klosterman et al. (1961), hand-feeding and self-feeding steers were compared. Both methods of feeding involved rations with long and ground hay. They reported gains and feed efficiencies as shown below:

| Ration | Av. daily gain, lb. | Lb. feed/lb. gain |
|---|---|---|
| Complete mixture self-fed | 2.09 | 10.65 |
| Hay-corn mixture, soybean meal self-fed | 2.2 | 11.30 |
| Hay-corn mixture, soybean meal-urea mixture self-fed | 2.11 | 11.22 |
| Corn-soybean meal mixture, long hay self-fed | 1.98 | 11.01 |
| Corn-soybean mixture hand fed, long hay self-fed | 2.03 | 12.60 |
| Corn-soybean meal and hay hand fed | 2.07 | 11.68 |

The addition of the urea to the self-fed soybean oil meal reduced the daily consumption of soybean meal from 5.1 pounds to 1.8 pounds per head daily, but the steers consumed an excess of crude protein due to the high nitrogen content of the urea. In a second trial by these workers, salt was added to the protein supplement and it reduced intake. Also, in the second trial, there was very little difference in gains, feed efficiencies, or carcass characteristics of steers fed by the different methods. The cattle used in these studies were calves weighing 500-600 pounds. Both of the trials reported involved long feeding periods (231 days and 252 days). These workers reported an undetermined amount of the long hay was wasted by the cattle. Potter et al. (1931) stated that chopping reduced the amount of hay wasted by cattle.

In comparing ground hay with long hay in a finishing ration, Stanley and Walker (1940) found daily gains, feed costs and feed efficiency by steers fed both types of hay were almost identical. The other constituents of the ration were hegari silage and cottonseed meal. Gerlaugh (1928) reported only slightly better gains by chopping the hay fed to slaughter steers.

Peters (1931) and Wilson et al. (1930) found no advantage of grinding hay for beef steers as measured by daily gains, feed efficiency and costs of feed per unit of gain. Costs of grinding were not included in the financial results, however. In a digestion trial by Wilson et al. (1930), digestibility of a ration was not increased by grinding or by grinding and mixing the roughages.

# CHAPTER III

## EXPERIMENTAL PROCEDURE

This investigation was carried out at the Main Experiment Station, University of Tennessee, Knoxville, during the summers of 1960 and 1961.

The system by which the steers were handled, preceding and during this test, was recommended by Duncan (1958), after investigations from 1947 through 1950. This system consists of wintering heavy weanling calves on a high roughage ration, pasturing them during the spring and early summer and then finishing them by full feeding in dry lot for a short period.

### Animals

Forty-eight yearling Angus and Hereford steers in 1960 and 40 yearling Angus and Hereford steers in 1961 were assigned to outcome groups by weight and grade. The steers averaged grading standard and weighed 702 and 760 pounds in 1960 and 1961, respectively. From the outcome groups the steers were put into eight lots averaging approximately the same weight and type grade, with the same number of each breed in each lot. The lots were randomly assigned to treatments, with two replications (two lots) per treatment each year.

These steers were either purchased at the Knoxville Feeder Calf Sale or raised on the experiment station farm the preceding year. The calves were from 7 to 10 months old when purchased or

weaned. All the steers were treated similarly up until the finishing period, being wintered on silage and a small amount of concentrate (5 pounds or less), then pastured on orchardgrass and ladino clover until assigned to the treatments (finishing period). The steers were 17 to 20 months old at the beginning of the test.

The steers were weighed two consecutive days at the beginning and at the end of the experiment (the average weights of the two days were used for the test beginning and ending weights). At the same time the steers were graded by two members of the Animal Husbandry Department staff. The steers were weighed once every 28 days during the trial. Each steer was implanted with 24 milligrams stilbestrol at the initiation of the trial. Steers were on feed 98 and 84 days in 1960 and 1961, respectively. To control flies and lice, the steers were sprayed twice during the trial with a mixture of malathion and DDT.

An open pole type barn divided into 13' X 20' lots under cover and 13' X 24' concreted outside area was used. Six steers in 1960 and 5 steers in 1961 were assigned to each lot. The feed bunks, which were located adjacent to the center feed alley of the barn, were 12' in length. Cattle were allowed free access to salt and dicalcium phosphate in separate containers and to water supplied by Nelson water bowls.

Feeding Methods and Rations

The ration fed to steers on treatments 1, 2 and 3 was 90 per cent ground shelled corn and 10 per cent cottonseed meal by weight

with long hay fed ad libitum, except for the last 28 days of the 1961 feeding test, when 6 per cent liquid molasses replaced an equal amount of corn. Treatment 4 cattle received a mixture of 63 per cent ground shelled corn, 8 per cent cottonseed meal, 25 per cent ground hay, 3 per cent liquid molasses, 0.5 per cent salt, and 0.5 per cent dicalcium phosphate.

All of the corn used was U.S.D.A. No. 2 yellow corn and was ground with a Peerless roller mill, adjusted so as to only crack each kernel. The hay used was good quality mixed alfalfa-orchardgrass. The hay for the mixed ration was ground with a John Deere 114A roughage mill equipped with knives that chopped the hay before it went through the hammers. A 3/4" screen was used in the mill. The rations were mixed with a two ton, twin spiral Prater mixer. After mixing, the feed was weighed into burlap bags to facilitate record keeping and hauled to the feeding barn. Samples of all the hay used and of the completely mixed rations were taken periodically and chemically analyzed by standard A. O. A. C. (1955) methods. These data are shown in Table I.

The specific treatments studied in this experiment were as follows:

1. Full-fed concentrates once each day, long hay ad libitum
2. Full-fed concentrates twice each day, long hay ad libitum
3. Self-fed concentrates, long hay ad libitum
4. Self-fed mixed rations containing ground hay

Steers on treatments 1, 2 and 3 were started on 5 pounds of concentrates per steer daily and increased 1 pound each day until each

TABLE I

AVERAGE CHEMICAL COMPOSITION OF THE RATIONS (AIR DRY BASIS)

| Ration | Moisture | Crude protein | Ash | Ether extract | Nitrogen free extract | Crude fiber |
|---|---|---|---|---|---|---|
| | | | Per cent | | | |
| 90% corn, 10% CSM | 13.2 | 12.6 | 1.86 | 4.08 | 65.99 | 2.85 |
| 86% corn, 10% CSM, 6% liquid molasses | 15.4 | 13.2 | 2.4 | 3.20 | 63.34 | 2.73 |
| Mixed alfalfa orchardgrass hay | 10.64 | 12.47 | 5.44 | 2.15 | 41.07 | 28.20 |
| 63% corn, 25% hay, 8% CSM, 3% molasses .5% salt, .5% dical. | 16.61 | 11.73 | 4.01 | 3.47 | 55.2 | 9.03 |

steer was consuming approximately 15 pounds. Then the feed increase per steer was reduced to 1/2 pound daily. The steers were considered "on feed" when they stopped cleaning up the feed in the trough by the next feeding.

Steers on treatment 4 were brought on full feed by starting them on a self-fed ration of 60 per cent ground hay, 28 per cent corn, 8 per cent cottonseed meal, 3 per cent molasses, 0.5 per cent salt and 0.5 per cent dicalcium phosphate. The concentrates were increased approximately 15 per cent each seven days to replace the same weight of ground hay.

Carcass Information

The steers were slaughtered at the East Tennessee Packing Company, Knoxville. They were tagged for identification and hot carcass weights were obtained on the kill floor. After 48 hours in the cooler, a carcass side was separated into fore-and hind quarters between the last two ribs (12th and 13th). A tracing was made of the cut surface of the rib-eye muscle and fat layer over the muscle. A compensating planimeter was used to measure the area of the rib-eye muscle from the tracing. Fat thickness measurement was taken from the tracing.

U. S. D. A. carcass grades and approximate percentages of kidney fat were obtained by a federal grader. The method proposed by Cole et al. (1962) was used to predict percentages of separable lean in the carcasses. U. S. D. A. yield grades and percentages of lean from the loin, rib, round and chuck (Murphy et al., 1960) were calculated only in 1960, because the per cent of kidney fat was available only that year.

Statistical Analyses

Data were analyzed by analysis of variance (Snedecor, 1956) and differences among all possible comparisons were tested for significance by the use of the multiple range test (Duncan, 1955).

## CHAPTER IV

## RESULTS AND DISCUSSION

The data were summarized for the two years, 1960 and 1961, and the results are presented in Tables II and III. Figure 1 shows the gains of the steers by 28-day periods. Results of steer performance and carcass information for each year are presented in Tables VI through IX. Reference may be made to these data where detailed information is desired. A detailed study of time requirements for feed preparation and feeding is presented in Table IV. Analyses of variance for performance and carcass data are given in Table V.

For simplicity, the four treatments will hereafter be referred to as treatment 1, treatment 2, treatment 3 and treatment 4, i.e. 1, concentrates fed once daily, long hay ad libitum; 2, concentrates fed twice daily, long hay ad libitum; 3, concentrates and long hay self-fed separately; and 4, mixed ration self-fed.

### Gains and Feed Efficiencies

The average daily gains were 2.98, 3.08, 3.17 and 3.30 pounds for treatments 1, 2, 3 and 4, respectively. This trend was evident both years but the difference between steers on the highest gaining and lowest gaining treatments was less in 1960 than in 1961. This might in part be due to the feeder as there was a different feeder for each year. Daily gains by steers on treatment 4 were significantly greater than the gains for those on treatment 1 ($P < .05$). There was

TABLE II

PERFORMANCE OF STEERS FED BY VARIOUS METHODS, 1960-1961
TWO YEAR SUMMARY

| Figures are averages of 4 lots with 22 steers per treatment | Treatments 1 Fed conc. once daily, long hay ad lib. | 2 Fed conc. twice daily, long hay ad lib. | 3 Self-fed[a] conc. long hay ad lib. | 4 Self-fed mixed ration |
|---|---|---|---|---|
| Av. wt. and gain/head, lb. | | | | |
| Initial wt. | 730.5 | 729.5 | 734.0 | 731.0 |
| Final wt. | 1000.5 | 1009.0 | 1021.0 | 1030.0 |
| Total gain | 270.0 | 279.5 | 282.0 | 299.0 |
| Daily gain* | 2.98 | 3.08 | 3.17 | 3.30 |
| Av. daily ration, lb. | | | | |
| Cottonseed meal | 1.93 | 1.83 | 1.98 | 1.93 |
| Corn | 16.76 | 15.90 | 17.16 | 16.38 |
| Hay | 6.13 | 6.14 | 5.74 | 8.02 |
| Molasses | 1.04 | 0.99 | 1.05 | 0.61 |
| Salt | 0.07 | 0.07 | 0.08 | 0.18 |
| Dical. | 0.05 | 0.06 | 0.07 | 0.18 |
| Air-dry feed/cwt. gain, lb. | | | | |
| Cottonseed meal | 64.3 | 56.9 | 63.0 | 57.6 |
| Corn | 559.8 | 512.5 | 548.8 | 493.1 |
| Hay | 203.9 | 196.0 | 183.5 | 239.0 |
| Molasses | 19.1 | 16.3 | 16.9 | 18.1 |
| Salt | 1.8 | 1.7 | 1.8 | 5.1 |
| Dical. | 1.1 | 1.2 | 1.5 | 5.1 |
| Total | 850.3 | 784.6 | 815.5 | 818.0 |
| Feed cost/head | $53.04 | $50.68 | $53.53 | $56.46 |
| Feed cost/lb. gain | .1959 | .1815 | .1895 | .1889 |

[a]One animal removed in 1961 due to causes other than treatments.

*Treatment $4 > 1$, ($P < .05$).

TABLE III

SUMMARY OF GRADES AND CARCASS INFORMATION OF STEERS FED BY DIFFERENT METHODS--1960 AND 1961

| Average of 4 lots per treatment | Treatments 1 Fed conc. once daily, long hay ad lib. | 2 Fed conc. twice daily, long hay ad lib. | 3 Self-fed conc. long hay ad lib. | 4 Self-fed mixed ration |
|---|---|---|---|---|
| Live grades | | | | |
| Initial type[a] | 10.7 | 10.5 | 10.5 | 10.4 |
| Initial condition[a] | 7.4 | 7.3 | 7.3 | 7.1 |
| Final condition[a] | 10.0 | 9.9 | 10.1 | 10.4 |
| Carcass information | | | | |
| U.S.D.A. grades[a] | 10.2 | 10.0 | 9.3 | 10.2 |
| Dressing percentage | 59.8 | 59.2 | 59.2 | 59.4 |
| Chilled carcass wt. lbs. | 597.0 | 590.4 | 594.0 | 598.6 |
| Fat thickness over rib-eye, in. | 0.57 | 0.57 | 0.55 | 0.56 |
| Rib-eye area, sq. in. | 11.30 | 11.03 | 11.53 | 11.49 |
| Kidney fat percentage[b] | 2.6 | 2.8 | 2.6 | 2.6 |
| U.S.D.A. yield grade[bc] | 2.6 | 3.0 | 2.8 | 2.7 |
| Predicted percentage of boneless cuts from loin, round, rib and chuck[bc] | 50.2 | 52.0 | 50.8 | 51.0 |
| Predicted percentage separable lean[d] | 51.5 | 51.9 | 51.9 | 51.8 |
| Total number animals | 18 | 19 | 19 | 21 |

[a]Scores for grades are: 7, Av. Standard; 8, High Standard; 9, Low Good; 10, Av. Good; 11, High Good; 12, Low Choice.

[b]Based on 1961 averages only.

[c]Murphy et al. 1960.

[d]Cole et al. 1962.

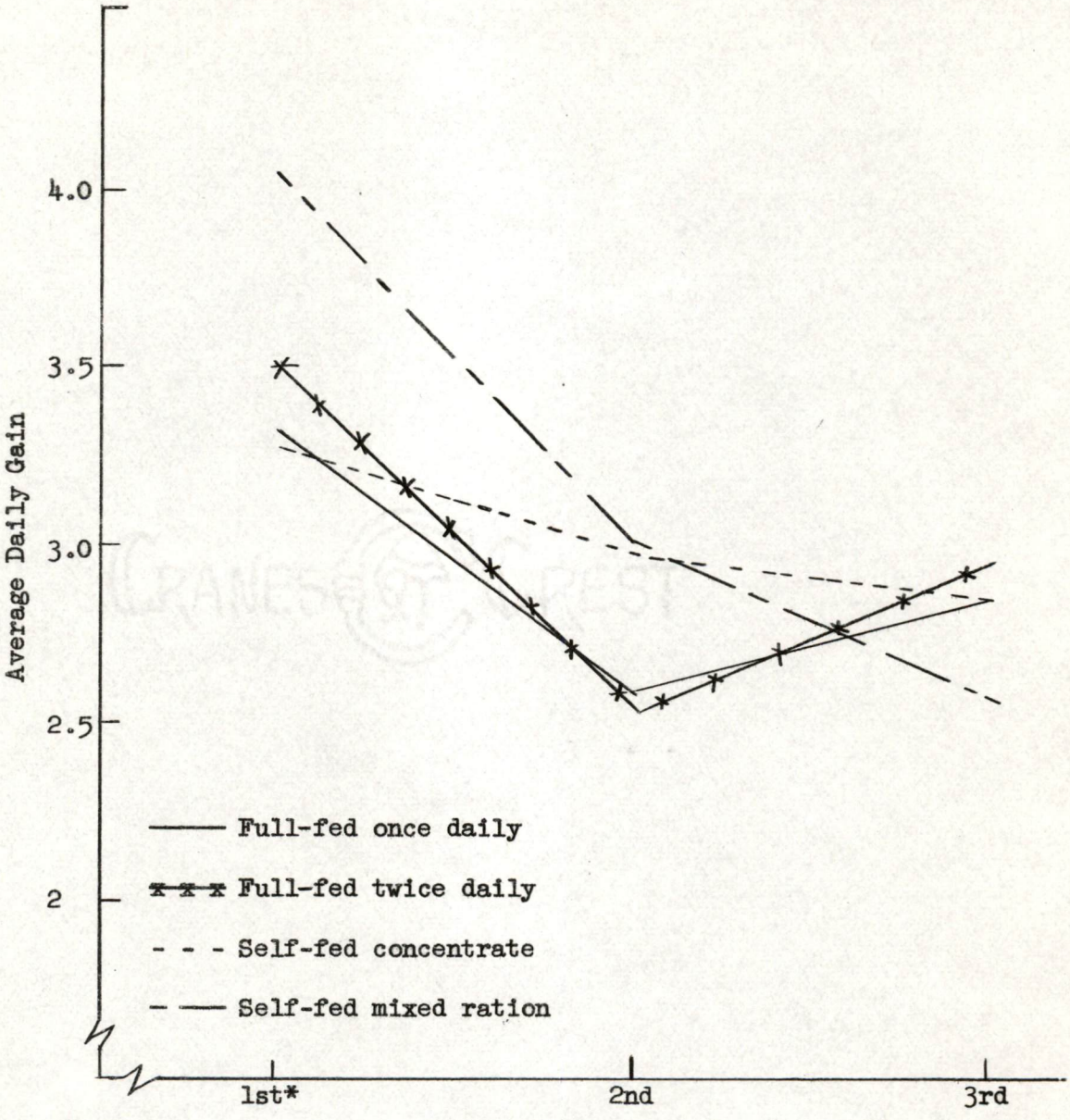


FIGURE 1

AVERAGE DAILY GAINS BY 28 DAY PERIODS
FOR STEERS FED BY DIFFERENT METHODS

*Period 1 $>$2 and 3 ($P < .05$).

TABLE IV

AVERAGE TIME REQUIRED TO PREPARE AND FEED ONE LOT OF FIVE STEERS BY DIFFERENT METHODS--1961

| Feed handling and preparation (84 days) | Treatments 1 Fed conc. once daily, long hay ad lib. | 2 Fed conc. twice daily, long hay ad lib. | 3 Self-fed conc. long hay ad lib. | 4 Self-fed mixed ration |
|---|---|---|---|---|
| | | Minutes | | |
| Grinding | | | | |
| Corn | 60.1 | 58.5 | 58.1 | 59.0 |
| Hay | | | | 289.0 |
| Mixing and bagging | 185.8 | 180.6 | 179.7 | 690.1 |
| Hauling | 67.0 | 78.0 | 64.5 | 87 |
| Feeding | | | | |
| Concentrate | 160.3 | 232.3 | 115.8 | 110.0 |
| Hay | 390.5 | 414.5 | 357.0 | |
| Total | 863.7 | 963.9 | 775.1 | 1235.1* |
| Av. total time per steer | 172.7 | 192.8 | 155.0 | 247.0 |
| Av. time per steer per day | 2.06 | 2.29 | 1.85 | 2.94 |

*Treatment 4 $>$ 1, 2, and 3 ($P < .05$).

TABLE V

ANALYSES OF VARIANCE FOR DAILY GAIN, FEED EFFICIENCY CARCASS DATA, AND TIME STUDY

| | | | Mean squares | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Source of variation | d.f. | Daily gain | Feed/cwt. gain | Final grade | Carcass grade | Dressing per cent | Carcass lean per cent | Time |
| Summary of two years | Total | 15 | | | | | | | |
| | Years | 1 | .3249 | 37,645.6 | .640 | 1.000 | 16.200 | 11.220 | |
| | Hand feeding vs. self-feeding | 1 | .1681** | | | | | | |
| | Treatments | 3 | .0783* | 2,840.6 | .177 | .800 | .573 | .066 | |
| | Years X treatments | 3 | .0102 | 1,638.7 | .090 | .350 | .617 | 1.107 | |
| | Error | 8 | .0178 | 1,362.8 | .165 | .361 | .494 | 1.418 | |
| Summary of 28 day periods for two years | Total | 48 | | | | | | | |
| | Years | 1 | 2.480** | | | | | | |
| | Treatments | 3 | .173 | | | | | | |
| | Periods | 2 | 3.0845* | | | | | | |
| | Treatments X periods | 6 | .3373 | | | | | | |
| | Years X treatments | 3 | .0603 | | | | | | |
| | Years X periods | 2 | .1040 | | | | | | |
| | Years X treatments X periods | 6 | .2110 | | | | | | |
| | Error | 24 | .1778 | | | | | | |
| Time required for feed prep. & feeding 1961 | Total | 7 | | | | | | | |
| | Treatments | 3 | | | | | | | 80,112* |
| | Error | 4 | | | | | | | 8,444 |

*Significant at .05.

**Significant at .01.

no significant difference among the daily gains of treatments 1, 2 and 3 or 2, 3 and 4. In an orthogonal comparison, daily gains of self-fed steers were highly significantly different from the gains of hand-fed steers ($P < .01$).

In an attempt to explain the higher gains of self-fed steers, the gains were broken down by 28-day periods as shown in Figure 1. These periods gains were tested statistically. Gains made during the first 28-day period were found to be significantly higher than those of the latter two periods ($P < .05$), but there was no significant difference among treatments within each of the periods.

The feed required per hundred pounds gained was 850.3, 784.6, 815.5 and 818.0 pounds for treatments 1, 2, 3 and 4, respectively. There was a similar trend in feed efficiencies both years, with steers on treatment 1 requiring the most feed both years. However, there were no statistically significant differences in feed efficiencies among the treatments. The feed required per hundred pounds of gain was less in 1961 than 1960, which may have been due to a shorter feeding period in 1961 (84 days vs. 98 days).

Steers on treatment 3 were hand full-fed twice daily until the steers were "on feed", which required about 26 days. Daily gains for the steers on this treatment were less than those of steers on treatment 4 but the gains were similar to the other hand-fed methods tested as shown by data in Figure 1. When these steers were "on feed", the feeders were filled to capacity and not allowed to become empty. The first day these steers were on self-feeding, it was observed that they

had a tendency to gorge themselves, but they soon became accustomed to having feed before them at all times. Treatment 4 steers had the mixed ration before them at all times during the trial.

There was only one case of bloat observed throughout these tests. One steer in treatment 4 in 1960 bloated two days successively. He was treated the second day with Turcapsol and did not bloat again for the remainder of the experiment.

Though the self-fed steers were checked daily, a steer in treatment 3 had a negative gain during the second 28-day period. There were no signs of illness, but upon close observation the steer was found to be having trouble eating. The station veterinarian diagnosed the trouble as a fungus or viral infection of the mouth. The steer was removed from the treatment and its gains were not calculated with the other steers. This steer was accounted for in calculating the feed requirements for that lot.

The costs per pound of gain ranged from 19.59 cents (treatment 1) to 18.15 cents (treatment 2). The self-fed treatments were very close at 18.95 cents and 18.89 cents for treatments 3 and 4, respectively.

Grades and Carcass Information

A summary of the grades and carcass information is presented in Table III. The steers averaged grading Standard on condition and Good on type when the feeding trials were initiated. During the feeding trials the condition grade was raised to Good. After the slaughter the carcasses averaged grading Good, except for those carcasses from steers on treatment 3 in 1960. The carcasses of these

steers were graded slightly under the Good grade.

The final condition grades were 10.0, 9.9, 10.1 and 10.4[a] for treatments 1, 2, 3 and 4, respectively. There was no significant difference in final grades among treatments.

Carcass grades were very close to final condition grades. Treatment 3 was lowest both years. The carcass grades were 10.2, 10.0, 9.3 and 10.2[a] for treatments 1, 2, 3 and 4, respectively. When tested statistically, differences in carcass grades and dressing percentages among the various treatments were not significantly different.

Rib-eye areas and fat thicknesses over the rib-eye were measured both years. Rib-eye areas ranged from 9.03 square inches to 15.64 square inches with one steer in treatment 3 in 1961 having a loin eye area of 17.20 square inches.

U.S.D.A. yield grade and per cent of boneless lean from the loin, rib, round and chuck were calculated in 1961. These data could not be calculated in 1960 because kidney fat percentages were not available.

The predicted per cent of separable lean was calculated both years. This was calculated as a per cent of the chilled carcass. It ranged from a low of 50.2 per cent for steers on treatment 1 in 1960 to a high of 52.6 per cent for those on treatment 4 in 1961. Differences in predicted percentage of separable lean for the various treatments were not significant.

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[a]Scores for grades are 9, Low Good; and 10, Average Good.

Time Requirements For Feed Preparation and Feedings

Table V presents a summary of the time required for grinding, mixing, bagging, hauling and feeding the steers by the different methods. Time required for grinding grain and for hauling the ration for all treatments was very similar. Obviously the time required for feeding concentrates was proportional to the number of times fed daily. Grinding the hay used for treatment 4 required less time than feeding long hay to each of the other treatments. The time required for mixing and bagging was more than three times greater for treatment 4 than either of the other treatments. Facilities were not available to handle and weigh this feed in bulk, which would have cut this time down considerably. The total time required to prepare feed and feed steers on treatment 4 was significantly greater than that for the steers on either treatments 1, 2, or 3 ($P < .05$).

# CHAPTER V

## SUMMARY

A two year feeding experiment was conducted at the Main Experiment Station, University of Tennessee, in which the results of two methods of hand feeding and two methods of self-feeding yearling steers were compared. The hand feeding methods investigated were feeding once daily and feeding twice daily. The self-feeding methods studied were self-feeding free choice and self-feeding a mixed ration. Yearling steers weighing 650-800 pounds were placed in dry lot directly from pasture for a short feeding period. The tests were started in late July of 1960 and the first of August in 1961. The feeding periods were 98 and 84 days for 1960 and 1961, respectively. Performance in the feed lot and carcass characteristics were summarized for the two years. A time study was made in 1961 on feed preparation and feeding by the different methods.

In these studies, self-fed steers gained significantly ($P < .01$) more than those hand full-fed. Self-feeding a mixed ration gave higher gains than any of the other methods. Most of the difference in gain in favor of self-feeding a mixed ration was obtained the first 28 days. The steers had a higher feed consumption during this period which could account for some of the increase in gains.

A disadvantage of self-feeding was demonstrated in this study. That is, cattle being self-fed may not be observed as closely as cattle being hand-fed.

There were no apparent differences in carcass characteristics due to the different methods of feeding. This feeding period averaged raising the condition grades one full grade (Average Standard to Average Good).

In a time study of feed preparation and of feeding by the different methods, self-feeding a mixed ration was found to require significantly more time than the other methods tested. This can be greatly influenced by the processing equipment and handling procedure.

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# APPENDIX

TABLE VI

PERFORMANCE OF STEERS FED BY VARIOUS METHODS
(JULY 30 TO NOVEMBER 5, 1960--98 DAYS)

| Figures are averages of 2 lots with 6 steers each (12 steers per treatment) | Treatments 1 Fed conc. once daily, long hay ad lib. | 2 Fed conc. twice daily, long hay ad lib. | 3 Self-fed conc. long hay ad lib. | 4 Self-fed mixed ration |
|---|---|---|---|---|
| Av. wt. and gain/head, lb. | | | | |
| Initial wt.(7-30-60) | 703.0 | 703.0 | 706.5 | 699 |
| Final wt. (11-5-60) | 984.0 | 995.0 | 1001.5 | 1002 |
| Total gain (98 days) | 281.0 | 292.0 | 295 | 303 |
| Daily gain | 2.87 | 2.98 | 3.01 | 3.09 |
| Av. daily ration, lb. | | | | |
| Cottonseed meal | 1.94 | 1.80 | 2.02 | 1.90 |
| Corn | 16.83 | 15.59 | 17.46 | 16.36 |
| Hay | 6.40 | 5.94 | 6.00 | 7.71 |
| Molasses | | | | 0.59 |
| Salt | 0.04 | 0.04 | 0.04 | 0.16 |
| Dical. | 0.01 | 0.01 | 0.01 | 0.14 |
| Air-dry feed/cwt. gain, lb. | | | | |
| Cottonseed meal | 67.6 | 60.4 | 67.0 | 61.2 |
| Corn | 586.8 | 524.2 | 581.6 | 528.8 |
| Hay | 223.2 | 199.6 | 199.7 | 249 |
| Molasses | | | | 19.23[a] |
| Salt | 1.5 | 1.4 | 1.4 | 5.0 |
| Dical. | 0.4 | 0.3 | 0.4 | 4.6 |
| Total | 879.5 | 785.9 | 850.1 | 859.2 |
| Feed cost/head | $57.85 | $53.60 | $58.92 | $60.75 |
| Feed cost/lb. gain | .205 | .184 | .20 | .20 |

[a]Liquid molasses were calculated to 74.3 per cent dry matter base to permit comparisons of feed per hundred weight gain on approximate air-dry bases.

TABLE VII

PERFORMANCE OF STEERS FED BY VARIOUS METHODS
(AUGUST 4 TO SEPTEMBER 28, 1961--84 DAYS)

| Figures are averages of 2 lots with 5 steers each (10 steers per treatment) | Treatments 1 Fed conc. once daily, long hay ad lib. | 2 Fed conc. twice daily, long hay ad lib. | 3 Self-fed[a] conc. long hay ad lib. | 4 Self-fed mixed ration |
|---|---|---|---|---|
| Av. wt. and gain/head, lb. | | | | |
| Initial wt. | 758.0 | 756 | 761.5 | 763 |
| Final wt. | 1017.0 | 1023 | 1040.5 | 1058 |
| Total gain (84 days) | 259 | 267 | 279 | 295 |
| Daily gain | 3.08 | 3.18 | 3.32 | 3.51 |
| Av. daily ration, lb. | | | | |
| Cottonseed meal | 1.91 | 1.85 | 1.93 | 1.95 |
| Corn | 16.68 | 16.21 | 16.85 | 16.41 |
| Hay | 5.89 | 6.34 | 5.47 | 8.32 |
| Molasses[b] | 1.04 | 0.99 | 1.05 | .62 |
| Salt | 0.10 | 0.10 | .11 | .20 |
| Dical. | 0.09 | .11 | .13 | .21 |
| Air-dry feed/cwt. gain, lb. | | | | |
| Cottonseed meal | 60.9 | 53.4 | 58.9 | 54.0 |
| Corn | 532.8 | 500.8 | 516.0 | 457.4 |
| Hay | 184.5 | 192.4 | 167.3 | 228.9 |
| Molasses[b] | 38.27 | 32.5 | 33.93 | 16.98 |
| Salt | 2.01 | 1.94 | 2.2 | 5.29 |
| Dical. | 1.86 | 2.18 | 2.64 | 5.65 |
| Total | 820.4 | 783.2 | 780.9 | 768.3 |
| Feed cost/head | $48.22 | $47.75 | $48.13 | $52.17 |
| Feed cost/lb. gain | .1868 | .1789 | .1719 | .1768 |

[a]One animal removed due to causes other than treatments.

[b]Liquid molasses were fed only the last twenty-eight day period. Molasses were calculated to 74.3 per cent air-dry bases to permit comparison between treatments, feed consumed and feed per hundred weight gain.

TABLE VIII

GRADES AND CARCASS INFORMATION OF STEERS
FED BY DIFFERENT METHODS--1960

| Average of 2 lots each treatment | Treatments | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| | Fed conc. once daily, long hay ad lib. | Fed conc. twice daily, long hay ad lib. | Self-fed conc. long hay ad lib. | Self-fed mixed ration |
| Live grades | | | | |
| Initial type[a] | 10.3 | 9.9 | 9.9 | 10.0 |
| Initial condition[a] | 7.1 | 7.1 | 6.7 | 7.0 |
| Final condition[a] | 9.8 | 9.7 | 9.6 | 10.2 |
| Carcass information | | | | |
| U.S.D.A. grades[a] | 10.1 | 9.4 | 8.9 | 10.3 |
| Dressing percentage | 58.7 | 58.1 | 57.9 | 58.9 |
| Chilled carcass wt. lbs. | 587.7 | 580.1 | 575.5 | 579.2 |
| Fat thickness over rib-eye, in. | 0.69 | 0.59 | 0.66 | 0.65 |
| Loin eye area, sq. in. | 10.90 | 11.04 | 11.02 | 10.95 |
| Predicted percentage separable lean[b] | 50.2 | 51.7 | 50.8 | 51.0 |
| Total number animals | 8 | 9 | 10 | 11 |

[a]Scores for grades are: 6, Low Standard; 7, Av. Standard; 8, High Standard; 9, Low Good; 10, Av. Good; 11, High Good.

[b]Cole, et al., 1962.

TABLE IX

GRADES AND CARCASS INFORMATION OF STEERS
FED BY DIFFERENT METHODS--1961

| Average 2 lots each treatment | Treatments 1 Fed conc. once daily, long hay ad lib. | 2 Fed conc. twice daily, long hay ad lib. | 3 Self-fed conc. long hay ad lib. | 4 Self-fed mixed ration |
|---|---|---|---|---|
| Live grades | | | | |
| Initial type[a] | 11.0 | 11.1 | 11.1 | 10.7 |
| Initial condition[a] | 7.6 | 7.5 | 7.8 | 7.2 |
| Final condition[a] | 10.1 | 10.0 | 10.5 | 10.5 |
| Carcass information | | | | |
| U.S.D.A. grades[a] | 10.2 | 10.5 | 9.7 | 10.1 |
| Dressing percentage | 60.8 | 60.2 | 60.4 | 59.9 |
| Chilled carcass wt. lbs. | 606.2 | 600.7 | 612.5 | 618.1 |
| Fat thickness over rib-eye, in. | 0.45 | 0.54 | 0.44 | 0.47 |
| Loin eye area, sq. in. | 11.70 | 11.01 | 12.03 | 12.02 |
| Kidney fat percentage | 2.6 | 2.8 | 2.6 | 2.6 |
| U.S.D.A. yield grade[b] | 2.6 | 3.0 | 2.8 | 2.7 |
| Predicted percentage of boneless cuts from loin, round, rib and chuck[b] | 50.7 | 49.6 | 50.9 | 50.7 |
| Predicted percentage separable lean[c] | 52.9 | 52.0 | 52.9 | 52.6 |
| Total number animals | 10 | 10 | 9 | 10 |

[a]Scores for grades are: 7, Av. Standard; 8, High Standard; 9, Low Good; 10, Av. Good; 11, High Good; 12, Low Choice.

[b]Murphy, et al., 1960.

[c]Cole, et al., 1962.

TABLE X

FEED PRICES USED IN FEEDING METHODS STUDY

| Feed | Price/unit | Price/lb. |
|---|---|---|
| Corn (shelled) | $ 1.37/bu. | $0.0234 |
| Corn (ear) | 1.34/bu. | 0.0186 |
| Hay (alfalfa) | 34.00/ton | 0.017 |
| Cottonseed meal | 70.00/ton | 0.035 |
| Salt | 31.00/ton | 0.0155 |
| Dical. | 80.00/ton | 0.04 |
| Molasses | 33.00/ton | 0.0165 |