VARIOUS MILO ALL-CONCENTRATE RATIONS FOR GROWING AND FINISHING BEEF CATTLE

By

JAMES B. RASBERRY, JR., B.S. in Ag.

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CHAPTER I

INTRODUCTION

Wintering rations for beef calves are usually built around low-cost roughages, either winter range plus supplementation or winter range and small grain pasture. One of the major problems confronting the ranching industry on the High Plains of West Texas is the lack of adequate year-long forage supply. This forage deficiency may be caused by drouth, short growing season or heavy grazing. A large portion of range calves are retarded during the fall and winter seasons, and in many cases gains are interrupted or the animals are subjected to actual loss of weight. The potentialities for rapid growth that beef cattle possess are seldom fully realized except on liberal rations as in the production of baby beef. Thus, retardation of the range calves has been believed by many to result in later loss of at least part of the potential for rapid growth, efficiency of feed utilization, and production of high quality beef. This retardation of growth during the periods of forage deficiency is of major economic significance to the ranch operator.

The abundance of milo grain and milo grain by-products and the relative scarcity of roughages in the High Plains area has stimulated a great interest in all-concentrate rations for fattening beef cattle. Results from recent experiments indicate that ruminants can perform satisfactorily on all-concentrate rations not only for the finishing period, but also for longer periods of time. It therefore seems

reasonable to assume that during periods of drouth, it may be desirable to remove calves from the range to the drylot. Milo grain could then be utilized in all-concentrate rations for both growing and finishing.

The primary objectives of this study were as follows:

1. To determine the relative performance and deleterious effects, if any, of limited feeding (above maintenance) all-concentrate rations composed of dry-rolled milo, milo hominy feed[1], cottonseed meal, urea and a vitamin-mineral premix to growing calves.

2. To determine the performance, carcass characteristics and liver condition of the limited fed calves when subsequently fed ad libitum all-concentrate rations composed of dry-rolled milo, cottonseed meal and a vitamin-mineral premix during the finishing period.

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[1]"Milo hominy feed is a mixture of milo bran, milo germ, part of the starchy portion of the milo kernels or mixture thereof as produced in the manufacture of grain sorghum grits and refined meal and flour and must contain not less than 5% crude fat and not more than 6% crude fiber." NRC 708-8000. (Feed Bag Red Book, 1967).

CHAPTER II

LITERATURE REVIEW

Finishing performance and carcass characteristics of beef cattle are dependent upon genetic potential, prefinish and finish environment, with nutrition making a major contribution to the environment. Early studies by Waters (1908), Haecher (1920), Trowbridge et al. (1918), Moulton et al. (1922a,b) Wellington et al. (1954) and Hammond (1955) have contributed much basic information on the development of body parts and the effect of different planes of nutrition. McMeekan and Hammond (1940) reported that rapid early growth and slow later growth intensifies the early developing tissues of muscle and bone and inhibits the late developing tissue of fat. McMeekan (1940) in a study of muscle development found that growth occurred first by an increase in number of cells and later by an increase in cell size. Thus, the animal that is fed above maintenance in early life will therefore develop the maximum number of cells. Recent studies by Callow (1961), Young et al. (1955), Carroll et al. (1963), Carroll et al. (1964), Ralston et al. (1965) and Henrickson et al. (1965) have demonstrated the effects of energy deprivation of full versus limited feeding performance, compensatory carcass growth and carcass quality.

The ability of young beef cattle to survive on restricted intakes of protein and energy and to recover from the effects when feed becomes abundant again has been shown in the work of Winchester and Howe (1955),

Winchester and Ellis (1957) and Winchester et al. (1957) using identical twins. Calves restricted to maintenance allowances of protein and energy for six months, then fed for rapid gains took more time to reach the same slaughter grade but required essentially the same amount of digestible nutrients per pound of gain as calves fed liberally for rapid growth. This is in disagreement with Guilbert et al. (1944) and Guenther et al. (1965) who have shown that cattle which make a continuous maximum gain to a given weight are more efficient converters of nutrients than are those fed at levels which do not permit rapid development.

Pfander (1955), Simone et al. (1961) and Matthews and Bennett (1962) found no evidence of detrimental effect on meat quality from steers that had undergone protein deficiency during the period when growth is ordinarily rapid.

The abundance of milo grain and milo grain by-products and the relative scarcity of roughage in the High Plains area has stimulated a great interest in all-concentrate rations for fattening beef cattle. Durham et al, (1963), Durham (1966), Durham et al. (1966a), Kercher and Bishop (1963) Pope et al. (1963) and Albin and Durham (1967) have demonstrated the successful use of milo grain in all-concentrate rations. A review by Ellis (1965) covers the advantages and disadvantages of milo as the basic ingredient in all-concentrate rations.

Recent work by Shelton et al. (1951) shows that milo grain by-products can replace up to 50% of the grain in a ration. Durham et al. (1966b) shows that up to 60% milo hominy can be used in a fattening ration.

The use of barley in all-concentrate rations for limited-feeding of calves has been reported by Minyard (1965). The calves were fed eight pounds per head, per day. The successful use of milo all-concentrate

rations for dry-lot maintenance of beef cows has been shown in the work of Thomas and Durham (1964). The cows were maintained on eight pounds per head, per day for a two year period.

Urea is becoming increasingly important to the feeding industry (Reid, 1953; Stangel, 1963) as a substitute for protein. Urea should fit particularly well into the feeding of all-concentrate rations due to the readily available energy. It has been established that 25% of the total protein in a ration may be a non-protein nitrogen.

CHAPTER III

EXPERIMENTAL PROCEDURE

Procedure.

One hundred sixty Hereford steer calves were contracted[1] for custom feeding in a 112-day limited-fed feeding trial followed by a 151-day feeding trial on self-feeders. The original plan was to feed the limited-fed ration for 150 days and the self-fed regime for 120 days. Due to rather severe incidence of bloat, some variation was necessary.

The calves were weaned at the ranch on August 31 and were received at the Texas Tech Feedlot on September 1. They were immediately numbered by ear notching, vaccinated for blackleg, infectious bovine rhinotracheitis, malignant edema, injected with 800,000 I.U. of vitamin A and individually weighed. The average initial adjusted weight[2] was 373 pounds.

The animals were assigned by weight to eight pens of 20 calves each, using a stratified randomization technique. Each pen was concrete floored, measured 30x40 feet, was equipped with a bowl type waterer and a feed bunk along the front. Eight treatments and feeding levels were randomly assigned to the pens. The treatments were as follows:

Control Urea: A urea-milo base ration, fed at levels of seven and nine pounds daily. Pens 14 and 17

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[1]The Renderbrook Spade Ranch, Colorado City, Texas.

[2]Adjusted wt. $\frac{\text{Ranch wt.}}{\text{Tech wt.}}$ = factor x Tech wt. = adjusted wt.

Treatment 2: A urea-milo base ration, with 10% of the total being milo hominy, fed at levels of seven and nine pounds daily. Pens 15 and 18.

Treatment 3: A urea-milo base ration, with 20% of the total being milo hominy, fed at levels of seven and nine pounds daily. Pens 16 and 20.

Treatment 4: A cottonseed meal-milo base ration, fed at seven pounds daily, using milo versus 10% milo hominy. Pens 19 and 21.

The basal rations and percentage of milo hominy fed ad libitum is described by Durham et al. (1966b).

The chemical analysis[3] of the milo hominy feed (air dry basis) is as follows:

Moisture, %	11.38
Crude proetin, %	10.38
Ether extract, %	5.08
Crude fiber, %	4.00
NFE, %	66.97
Ash, %	2.19

Net energy values of the rations were calculated as shown by Lofgreen and Garrett (1968). The rations contained a mean of 79.59 ±0.69 megcal. per hundred pounds of feed for maintenance and 50.23 ±0.47 megcal. per hundred pounds of feed for production.

The physical composition of the eight limited-fed rations is shown in table 1.

The physical composition of Premix DD 1L and AL is shown in table 2.

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[3]Harvest Queen Mills, Plainview, Texas.

TABLE I

PHYSICAL COMPOSITION OF LIMITED-FED RATIONS

Item	Ration							
	14	15	17	18	19	21	16	20
Ingredient, %								
Milo, dry rolled	94.3	84.3	95.6	85.6	84.3	74.3	75.6	74.3
Milo hominy	---	10.0	---	10.0	---	10.0	20.0	20.0
Cottonseed meal	---	---	---	---	10.0	10.0	---	---
Premix DDIL (urea)	5.7	5.7	4.4	4.4	---	---	4.4	5.7
Premix AL (CSM)	---	---	---	---	5.7	5.7	---	---

TABLE 2

PHYSICAL COMPOSITION OF PREMIX DDIL AND AL

Item	Pounds of Ingredient/Ton	
	Premix DDIL[a]	Premix AL
Ingredients		
Limestone	665	800
Urea	518	---
Cottonseed meal	83	738
NaCl	106	360
Polyphos	316	80
KCL	280	---
Vitamin A (30,000 I.U./gm.)	14.5	14.5
Vitamin E (125,000 I.U./gm.)	1.4	1.4
Terramycin (50,000 mg./lb.)	5.5	5.5

[a]Contained additional minerals to supply those quantities normally supplied by cottonseed meal.

The calves were immediately started on feed according to the following procedure. All animals were hand-fed twice daily (morning and evening) at the rate of one pound per head per day on the first and second day

and increased 0.5 to 1.0 pounds per head per day until the animals reached their assigned feeding level. All feeding levels were reached in ten days and once a day feeding was started (mornings). This was discontinued after approximately 40 days due to incidence of bloat and twice a day feeding was resumed. The twice daily feeding was continued during the limited-fed period.

Treatments 14, 15, 19, 20 and 21 were fed seven pounds per head daily at the start of the experiment. This was increased by 0.5 pound increments during the period to compensate for growth rate to nine pounds per head daily at the end of 112 days, with the exception of treatment 20 which was terminated at 85 days due to bloat. Treatment 20 was then put on a self-fed basal ration. Treatments 16, 17, and 18 were fed nine pounds per head daily and increased by 0.5 pound increments to 11 pounds per head daily at the end of 112 days, with the exception of 16 which was terminated at 85 days due to bloat. Treatment 16 was then put on a self-fed basal ration.

The limited-fed phase was terminated for the remaining six pens at 112 days, as bloat was becoming a severe problem. These pens were then put on a self-fed basal ration by the following procedure. The basal ration was increased by 1.0 pound increments per head daily above the limited fed level until feed was left in the bunk. A 1000 pound capacity self-feeder was then placed in the pen and filled with the basal ration. The basal ration was as follows: 91% dry-rolled milo, 6% cotton-seed meal and 3% premix A with salt fed ad libitum. Premix A is the same as Premix AL shown in table 2, except that it contained stilbestrol in quantity to supply 10 mg. per head per day and utilized aureomycin rather than terramycin.

Ammonium chloride was added to the ration for a five day period at 70 and 165 days on feed. This was treatment for urinary calculi, which became symptomatic at these times.

The calves were individually weighed at approximately 28 day intervals during the feeding period. Overnight shrink was used during the limited-fed period. The intermittent and final weights after the animals were on self-feeders were arithmetically shrunk 4% to comply with this common practice in marketing.

The weights and calculated feed consumption were removed from the data for animals that either died or were removed during the experiment.

Since the animals were being custom fed, deviation from standard experimental procedure was necessary. The animals were marketed by topping and with cuts as would be the practice of commercial feedlots.

One calf each from treatment 15, 18, and 21 was slaughtered at the ends of 112 days to check for rumen parakeratosis and liver abscesses. An attempt was made to slaughter an average weight animal from an average pen.

Fifty-one animals with a live weight of 800 pounds and over were slaughtered by a local packer after 222 days on experiment.

Fourteen poor gainers were sold at a local livestock auction after 223 days.

Twelve animals with founder conditions were slaughtered along with four normal animals at 230 days. These were slaughtered at the Texas Tech Meat Laboratory for a study of the feet.

The remaining 66 animals were slaughtered by a local packer after 264 days on experiment.

Carcass.

Final weights were obtained the morning prior to slaughter and arithmetically shrunk 4%. This was used with the hot carcass weight shrunk 2.5% (packer option) to calculate dressing percent. Carcasses were graded after a 48-hour chill to the nearest one-third U.S.D.A. grade by a Federal grader. Conformation and marbling were taken to the nearest one-third grade. Final grade, conformation and marbling were numerically scored as outlined by the American Meat Science Association (1967). A tracing was made of the Longissimus Dorsi muscle at the 12th rib. Backfat thickness was measured in tenths of inches at a site 3/4 the length of the Longissimus Dorsi from the chine bone end (Epley and Stringer, 1966). A compensating polar planimeter was used to measure the rib-eye area to the nearest one-tenth square inch.

The data (excluding treatments 16 and 20) were subjected to analysis of variance according to the procedures of Steel and Torrie (1960). Treatments 14 - 15, 17 - 18, and 19 - 21 were used as replicates in the analysis, since no differences were observed in the milo and milo hominy comparisons.

CHAPTER IV

RESULTS AND DISCUSSION

Production.

Means of performance data obtained for the limited feeding phase are presented in table 3. The calves adjusted readily to the ration and reached or surpassed the adjusted pay weight in 22 days. Minor outbreaks of coccidiosis affected several animals during the first week on test.

TABLE 3

MEAN PERFORMANCE OF LIMITED FED CALVES ON DIFFERENT RATIONS AND AT DIFFERENT LEVELS OF INTAKE (POUNDS)

	Ration 112 Days							
Item	14	15	17	18	19	21	16[a]	20[a]
No. of animals	20	20	18[c]	20	20	19[d]	18[c]	16[bc]
Initial wt.[e]	372	373	377	372	370	373	373	376
Final wt.[f]	461	463	511	509	474	476	445	437
Daily gain[g]	0.80	0.80	1.19	1.22	0.93	0.92	0.85	0.72
Daily feed intake	7.51	7.54	9.02	9.03	7.66	7.57	8.64	7.17
Feed per lb. gain[g]	9.39	9.45	7.56	7.40	8.22	8.26	10.18	9.97

[a]85 days on limited.

[b]One social case removed.

[c]Seven died of bloat.

[d]One died of abscessed esophagus.

[e]Adjusted pay weight.

[f]With overnight shrink.

[g]17-18>14-15 & 19-21; P<.05.

The incidence of bloat resulted in the abandonment of the two 20% milo hominy treatments at 85 days. Two animals died of bloat in treatments 16 and three in treatment 20. The previous work of Durham et al. (1966b) shows no incidence of bloat in ad libitum rations containing 60% milo hominy. Some bloat was encountered in the other six treatments, with two animals dying later in treatment 17. The study suggests that timid or poor gaining calves were the chronic bloaters. This seems to indicate that a social order was established in the pens due to the strict confinement and limited feeding. Previous studies at this station have indicated (Durham, 1968) that bloat may become a problem when all-concentrate rations are not fed ad libitum. Since ad libitum is approximately two percent of the live animal weight for all-concentrate rations, it is postulated that the timid animals did not receive their share of the rations, and hence developed digestive disturbances.

No differences were observed between milo and milo hominy rations otherwise treated alike. The comparisons discussed henceforth will therefore consider these as two replicates each of three treatments.

The gains for cottonseed meal treatment (19-21) were significantly P .05 higher than for the urea treatment (14-15). Feed conversion was significantly P<.05 in favor of cottonseed meal treatment. This is in agreement with Durham et al. (1966a) and Durham et al. (1967) using ad libitum rations.

The severely limited (7.5 pounds average) treatments (14-15) and (19-21) produced significantly P .05 lower gains and poorer feed conversion than the modestly limited (9.0 pounds average) treatments (17-18). This could be expected due to a greater intake for (17-18) which should have provided more available nutrients above maintenance needs.

Data obtained from the self-feeding period are presented in table 4. The results of this phase provided an interesting contrast and showed the effect of compensatory growth. Compensatory growth became evident when the animals were placed on self-feeders. The low level treatments which did poorly, now excelled the high level treatments as shown in table 4.

TABLE 4

MEAN PERFORMANCE OF CALVES LIMITED FED WHEN SUBSEQUENTLY FED A BASAL RATION AD LIBITUM (POUNDS)

	129 Days[a]							
Item	14	15	17	18	19	21	16	20
No. of animals	20	19[d]	18	19[d]	20	18[d]	18[b]	15[bc]
Initial wt.[e]	461	463	511	509	474	476	445	441
Final wt.[f]	769	773	776	789	770	785	806	815
Daily gain[g]	2.38	2.46	2.05	2.13	2.29	2.37	2.32	2.43
Daily feed intake	16.04	16.30	15.78	15.41	15.89	16.60	15.69	16.58
Feed per lb. gain[g]	6.75	6.62	7.69	7.24	6.89	7.00	6.76	6.81

[a]Average animal days on self-feeder.

[b]154 average animal days on self-feeder.

[c]One died of choke.

[d]Three slaughtered at 112 days.

[e]With overnight shrink.

[f]Shrunk 4%

[g]17-18<14-15 & 19-21; $P<.05$.

Calves which had been severely restricted while on the urea supplement (14-15) made the best gains, with better feed conversion on the ad libitum regime. Calves which had been severely limited with cottonseed meal as the supplement (19-21) now showed inferior performance to the severely restricted urea fed animals (14-15) but superior performance to the modestly restricted urea groups (17-18). The modestly re-

restricted urea groups (17-18) showed significantly $P<.05$ inferior feed conversions.

Several animals developed founder and stiffness near the end of the experiment. This was noted to be randomly distributed through the treatment groups.

The overall performance data obtained during the 264 day feeding trial are presented in table 5. Overall performance showed no substantial effect of feeding regime. The calves reached about the same weight and with the same feed conversion irrespective of treatment. These results support the conclusions drawn by Winchester et al. (1957). There was a suggestion in the data that the calves fed 10% milo hominy during the growing phase (15-18-21) had slightly better performance during the finishing and overall phase as shown in tables 4 and 5.

TABLE 5

MEAN OVERALL PERFORMANCE OF CALVES FED LIMITED AND AD LIBITUM ALL-CONCENTRATE RATIONS (POUNDS)

	241 Days[a]							
Item	14	15	17	18	19	21	16	20
Total gain	397	400	399	418	400	411	433	410
Daily gain	1.65	1.68	1.65	1.71	1.66	1.70	1.80	1.70
Daily feed intake	12.11	12.19	12.65	12.48	12.08	12.43	13.21	12.43
Feed per lb. gain	7.35	7.25	7.65	7.29	7.28	7.31	7.33	7.69

[a]Average animal days on feed.

Carcass.

The slaughter and carcass data are presented in table 6. Mean carcass information for the three calves slaughtered at 112 days is as follows: live weight 500 pounds, hot carcass weight 291 pounds, dressing

percent 60.0, rib-eye area 7.6 square inch (2.58 square inch/100 pounds), fat thickness 0.1 inch, U.S.D.A. grade: Good calf. The rumens and livers were observed to be normal.

TABLE 6

MEAN CARCASS CHARACTERISTICS OF CALVES FED LIMITED AND AD LIBITUM ALL-CONCENTRATE RATIONS

Item	14	15	17	18	19	21	16	20
No. of animals	19	16	16	17	16	16	18	15
Final wt.[a]	778	802	795	806	797	799	806	815
Hot carcass[b]	471	485	488	490	474	483	491	500
Dressing percent	60.50	60.41	61.44	60.82	59.45	60.45	60.96	61.34
U.S.D.A. grade[c]	10.6	10.4	11.5	10.9	10.7	10.6	10.9	11.1
U.S.D.A. marbling score[d]	7.0	7.1	9.2	8.1	7.7	7.4	8.5	8.3
U.S.D.A. conformation score[e]	12.2	12.7	13.1	12.5	12.2	12.3	12.5	13.5
Rib-eye area, sq.in.	9.8	10.1	10.1	9.9	10.1	10.3	10.3	10.3
Fat over rib-eye in.	.32	.32	.39	.34	.27	.29	.33	.37
Abscessed livers	2	2	1	5	2	0	3	0

[a]Shrunk 4%

[b]Shrunk 2.5%

[ce]Average = 10, Good plus = 11, Low choice = 12, Choice = 13, Plus = 14.

[e]Slight = 7, Slight plus = 8, Small minus = 9, Small = 10.

No difference was found in the treatments as shown in table 6; although, the marbling score advantage for the modestly limited treatments (17-18) approaches significance. This seems to indicate that the feeding level of these rations during the limited-fed phase provided enough nutrients for muscle and bone development, plus some fat deposition. Marbling scores were considered to be low for the length of time on feed.

This was thought to be due to the lack of genetic potential in the animals. The dressing percentage and conformation scores were relatively high in relation to the light weight at which the animals were slaughtered. These high dressing percentages are influenced by the lack of fill encountered in all-concentrate rations. The ratio of rib-eye area to hot carcass weight (average 2.02 square inch/100 pounds) was considered to be typical. Fat thickness was greater than expected, but is in agreement with the report by Zinn (1968).

Abscessed liver incidence was 11 percent. This was expected to be higher due to the length of time on all-concentrate rations. There was no effect of treatments indicated.

CHAPTER V

SUMMARY AND CONCLUSION

One hundred sixty weanling steer calves were used to study the effects of urea versus cottonseed meal supplementation, milo versus 10% and 20% milo hominy on performance, carcass characteristics and liver abscesses of cattle limited-fed (seven and nine pounds daily) and subsequently self-fed all-concentrate rations based on dry rolled milo. Feeding nine pounds versus seven pounds daily significantly increased performance during the growing phase. The seven pound groups gained more and used significantly less feed per pound of gain during the self-fed phase. Incidence of bloat was severe during the limited-fed phase. Compensatory growth rate occurred after animals were placed on a higher plane of nutrition. These animals produced normal carcasses. Liver abscesses were 11 percent.

From a practical point of view the following may be concluded:

1. If a cattleman owns the cattle in both phases, it matters not whether he limit-feeds seven or nine pounds daily.
2. If he is a grower, he will profit by feeding the nine pounds daily.
3. If he is a feeder, he will not want cattle which have been fed nine pounds daily during the growing phase.

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