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CORN-MOLASSES MIXTURES COMPARED WITH CORN FOR FATTENING BEEF CATTLE

MCCONAS, E.W. & DOUGLAS, J.R. SOUTHWEST B.L. 1 OF 1

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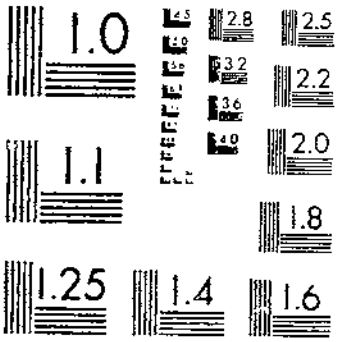

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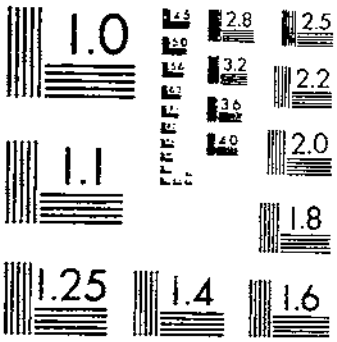

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NATIONAL BUREAU OF STANDARDS-1963-A

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UNITED STATES
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WASHINGTON, D. C.

Corn-Molasses Mixtures Compared With Corn for Fattening Beef Cattle in the Coastal Plain Area[1]

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INTRODUCTION

The improved quality of beef cattle, due to better breeding, in the Southeastern States in recent years justifies the feeding of greater quantities of concentrates to produce a higher grade of beef. However, in this region the supply of corn for cattle feeding is usually limited. On the other hand, in normal times a rather large quantity of blackstrap molasses is available.

An experiment in fattening yearling steers at Moultrie, Ga., in 1931 by the Bureau of Animal Industry, the Georgia Experiment Station, and Swift and Co. indicated that in a 112-day feeding period little difference in gains was produced by shelled yellow corn and by a mixture of three-fourths corn and one-fourth molasses, when fed with cottonseed meal, cottonseed hulls, and a mineral mixture. Financial returns were somewhat lower with the corn-molasses mixture than with corn, owing mainly to the 0.7 cent a pound higher cost of molasses. However, the estimated selling price of the animals fed molasses was 15 cents per 100 pounds lower than that of the other group.

The purpose of the experiments reported in this bulletin was to determine the comparative values, as steer-fattening feeds, of ground snapped corn and of mixtures of the corn and blackstrap cane molasses

[1] Submitted for publication, October 18, 1943.
[2] Now in the armed forces.
[3] Resigned March 7, 1941.

in the ratios of 1:1 and 3:1, when used with feeds common to the Coastal Plain—velvetbeans as a source of protein and peanut straw (threshed peanut hay) as roughage.

EXPERIMENTAL PROCEDURE

The first experiment was begun late in January 1937 and was completed in 112 days. Each of the three succeeding experiments was begun early in November and completed in 140 days. They were conducted at the Georgia Coastal Plain Experiment Station, Tifton, Ga., under a cooperative agreement between the Bureau of Animal Industry, the Georgia Experiment Station, and the Georgia Coastal Plain Experiment Station.

The cattle used in these experiments were Texas-raised, grade Hereford steers, about 18 months of age, that had been used in grazing experiments at the station during the year. All were graded as feeders by a 3-man committee that included a representative of the Agricultural Marketing Service, United States Department of Agriculture. The steers selected for each experiment—38, on the average, for the 4 years—were divided into 3 groups as uniformly as possible with respect to quality, conformation, and weight. Group 1 was fed a mixture of equal parts, by weight, of snapped corn and molasses; group 2, three-fourths snapped corn and one-fourth molasses; and group 3, no molasses. For a preliminary period of approximately 3 weeks before each experiment was begun, all groups received corn, velvetbeans, and peanut straw.

Each group was fed in an open, well-drained lot approximately 1½ acres in size. About 20 percent of the peanut straw that was fed in the first experiment was ground and mixed with the coarsely ground corn and velvetbeans to serve as a carrier for the molasses fed to groups 1 and 2. However, the greater portion of the peanut straw and the feed mixture was fed in separate, deep, open feed troughs. During most of the first experiment the molasses was diluted with water before being poured over the feed mixture, but in subsequent experiments the undiluted molasses was used. Salt and a mineral mixture in separate boxes were available to the steers at all times. The mineral mixture was composed of finely ground steamed bonemeal, ground limestone, and common salt, equal parts by weight.

The steers were fed twice daily. Refused feed was weighed periodically, deducted from the total quantity fed, and removed. The quantities of feeds refused were very small.

The steers were weighed individually on 3 consecutive days at the beginning of the experiment and on 3 consecutive days at its conclusion. The average of the 3-day weight of each steer at the beginning of the experiment was used as its initial weight, and that at the end as its final weight. At the end of each experiment the steers were sold at the station and hauled in trucks by the purchasing agency to its abattoir.

The kinds of feed used in these experiments and the price of each are shown in table 1. The salt, other minerals, and the molasses (in truck tanks), were purchased, but the other feeds were produced at the station. Prices of these conformed with those prevailing in the locality at the time each experiment began.

TABLE 1.—*Feed prices per ton during the experiments*

Feed	1936–37	1937–38	1938–39	1939–40
Corn, ground snapped	$30.00	$17.50	$16.24	$18.74
Velvetbeans and pods, ground	20.00	10.00	14.00	20.00
Blackstrap molasses	24.00	20.00	16.06	20.00
Peanut straw, unground	10.00	8.00	9.00	9.00
Peanut straw, ground	12.00			
Minerals	26.00	26.00	26.00	26.00

RESULTS OF EXPERIMENTS

EXPERIMENT 1 (1937)

A summary of the results obtained in the first experiment is given in table 2.

TABLE 2.—*Summary of first experiment, Jan. 22, 1937, to May 14, 1937 (112 days)*

Item		Group 1, fed 1 part snapped corn to 1 part molasses,+ velvetbeans and peanut straw	Group 2, fed 3 parts snapped corn to 1 part molasses,+ velvetbeans and peanut straw	Group 3, fed snapped corn, velvetbeans, and peanut straw
Steers used	number	11	11	11
Average initial weight at feed lot	pounds	530	533	553
Average final weight at feed lot	do	791	813	836
Average total gain per steer	do	261	280	283
Average daily gain per steer	do	2.33	2.50	2.53
Total feed consumed per steer:				
Corn	do	760	1,047	1,540
Velvetbeans	do	496	494	496
Molasses	do	739	473	
Unground peanut straw	do	480	453	
Ground peanut straw	do	128	128	315
Minerals	do	6.8	6.8	128
Average ration:				7.3
Corn	do	6.79	9.35	13.75
Velvetbeans	do	4.43	4.41	4.43
Molasses	do	6.60	4.22	
Unground peanut straw	do	4.29	4.04	
Ground peanut straw	do	1.14	1.14	2.81
Minerals	do	.06	.06	1.14
Feed required per 100 pounds of gain:				.07
Corn	do	291	374	544
Velvetbeans	do	190	176	175
Molasses	do	283	169	
Unground peanut straw	do	184	162	
Ground peanut straw	do	49	46	111
Minerals	do	2.6	2.4	45
Value of feed per 100 pounds of gain	dollars	9.16	10.52	2.6
Initial cost per steer at $6.69 per 100 pounds of live weight	do	35.46	35.66	10.77
Cost of feed per steer	do	28.49	29.46	37.00
Total cost of steer at feed lot	do	63.95	65.12	30.49
Sale price per 100 pounds of live weight	do	8.30	8.47	67.49
Gross return per steer	do	65.65	68.86	8.38
Profit per steer	do	1.70	3.74	70.06
Average feeder grade		(1)	(1)	2.57
Average carcass grade		(2)	(3)	(1)
Average dressing percentage	percent	56.9	56.1	(3) 55.9

[1] Low Good.
[2] High Medium.
[3] Average Medium.

Group 1 steers, receiving equal quantities of corn and molasses, averaged approximately 7.8 percent less total gain per head than group 3, receiving no molasses. The former group consumed 2.7 percent less carbohydrate concentrates but 37.2 percent more peanut

straw. The group 2 steers, which received 3 parts of corn to 1 part of molasses, gained essentially the same as those in group 3, and the carbohydrate concentrates required were about the same. The smaller amount of carbohydrate concentrates fed to group 1 than to group 3 was compensated for by additional straw, as measured by the sale prices. Group 1, fed approximately the same quantities of carbohydrate concentrates as were fed to group 2, sold for $0.17 less per 100 pounds. Therefore, the 6 percent additional straw fed to the former group apparently was of no benefit to the animals.

Although the average dressing percentage of the group 1 steers was higher than that of the other two groups, differences between the three groups were not statistically significant ($p>0.05$)[4]. Differences between the average carcass grades of the three groups were likewise not statistically significant.

The profits from group 1 were $0.87 a head less than those from group 3, but the profits from group 2 were $1.17 more than those from group 3.

Thus in the 1937 experiment, feeding a ration whose carbohydrate concentrate consisted of three-fourths corn and one-fourth molasses gave results that were more satisfactory than one that consisted either entirely of corn or of one-half corn and one-half molasses.

Experiment 2 (1937–38)

Data pertaining to the second experiment are shown in table 3. When the experiment was begun the steers weighed a little over 100 pounds a head more than those used in the first experiment. They were fed 28 days longer than those in the first experiment. The feeds used were similar in quality to those fed the previous year, but the steers averaged two-thirds of a grade lower as feeders.

The group 1 steers, receiving equal quantities of corn and molasses, averaged 13.3 percent less gain than those in group 3, receiving no molasses, and consumed essentially the same quantities of carbohydrate concentrates but 91.3 percent more peanut straw. Group 2 steers, receiving 3 parts of corn to 1 part of molasses, averaged 10.2 percent less gain than those in group 3 on about the same quantities of carbohydrate concentrates and 74.4 percent more straw. In this experiment the corn-molasses mixture in the ratio of 1:1 was 86 percent as valuable as corn in terms of steer gain produced, whereas the mixture in the ratio of 3:1 was 92 percent as valuable.

Differences in average carcass grade and dressing percentages of the steers in the three groups were not statistically significant ($p>0.05$). In this experiment the cost of feed per steer for group 1 averaged $2.65 a head more than that for group 3, and the sale price per 100 pounds of live weight of group 1 was $0.25 less than that of group 3. Similarly, the feed cost per steer for group 2 was $1.46 more than that for group 3, and the sale price per 100 pounds of live weight was $0.48 less. Thus from a financial standpoint results with the groups fed molasses were not only markedly less satisfactory than those with the group fed no molasses, but in each case their gains also were not sufficient to offset their higher feed cost. The fact that molasses

[4] Snedecor, G. W. Statistical methods applied to experiments in agriculture and biology. Ed. 3, 422 pp., illus. Ames, Iowa. 1940.

fed in this experiment cost $2.50 a ton more than ground snapped corn contributed to the higher feed cost per steer.

TABLE 3.—*Summary of second experiment, Nov. 3, 1937, to Mar. 23, 1938 (140 days)*

Item	Group 1, fed 1 part snapped corn to 1 part molasses, +velvetbeans and peanut straw	Group 2, fed 3 parts snapped corn to 1 part molasses, +velvetbeans and peanut straw	Group 3, fed snapped corn velvetbeans, and peanut straw
Steers used ... number	12	12	12
Average initial weight at feed lot ... pounds	661	663	670
Average final weight at feed lot ... do	934	946	985
Average total gain per steer ... do	273	283	315
Average daily gain per steer ... do	1.94	2.02	2.25
Total feed consumed per steer:			
Corn ... do	1,188	1,587	2,179
Velvetbeans ... do	739	739	738
Molasses ... do	1,001	560	----------
Peanut straw ... do	679	619	355
Minerals ... do	14	11	13
Average ration:			
Corn ... do	8.49	11.34	15.56
Velvetbeans ... do	5.28	5.28	5.28
Molasses ... do	7.15	4.00	----------
Peanut straw ... do	4.85	4.42	2.54
Minerals ... do	.10	.08	.09
Feed required per 100 pounds of gain:			
Corn ... do	435	561	692
Velvetbeans ... do	271	261	235
Molasses ... do	367	198	----------
Peanut straw ... do	249	219	113
Minerals ... do	5.1	3.9	4.1
Value of feed per 100 pounds of gain ... dollars	10.70	9.90	8.43
Initial cost per steer at $7.80 per 100 pounds of live weight ... do	51.50	51.71	52.26
Cost of feed per steer ... do	29.21	28.02	26.56
Total cost of steer at feed lot ... do	80.77	79.73	78.82
Sale price per 100 pounds of live weight ... do	8.60	8.37	8.85
Gross return per steer ... do	80.32	79.18	87.17
Profit or loss per steer ... do	−0.45	−0.55	+8.35
Average feeder grade	(1)	(1)	(1)
Average carcass grade	(2)	(2)	(3)
Average dressing percentage ... percent	58.0	59.6	59.0

[1] Average Medium.
[2] Average Good.
[3] High Good.

EXPERIMENT 3 (1938–39)

Data pertaining to the third experiment are shown in table 4. When the experiment began, the average weight of the group 1 steers was somewhat greater than the weights of groups 2 and 3. The difference was unavoidable, however, owing to the necessity of giving consideration to other factors also in allocating the cattle. All groups ate the same quantities of concentrates and roughage, and the ratio of corn to molasses consumed was maintained at 1:1 and 3:1 for groups 1 and 2, respectively. The appearance of the 3 groups of steers at the end of the feeding period is shown in figure 1.

The group 1 steers averaged 31 percent less gain per head than those in group 3, which received no molasses, and the group 2 steers averaged 12.7 percent less. The relationship of group 1 to group 2 with respect to gain in weight corresponded rather closely to the ratio of nutrients in the carbohydrate-concentrate portion of their rations, particularly when the difference in their average initial weights is considered. The differences in gains of groups 1 and 2 and groups 1 and 3 were great enough to be statistically significant ($p<0.05$), and the difference in gains of groups 2 and 3 bordered on significance.

TABLE 4.—*Summary of third experiment, Nov. 18, 1938, to Apr. 7, 1939 (140 days)*

Item	Group 1, fed 1 part snapped corn to 1 part molasses, + velvetbeans and peanut straw	Group 2, fed 3 parts snapped corn to 1 part molasses, + velvetbeans and peanut straw	Group 3, fed snapped corn, velvetbeans, and peanut straw
Steers used ..... number	13	13	13
Average initial weight at feed lot ..... pounds	585	537	538
Average final weight at feed lot ..... do	841	861	909
Average total gain per steer ..... do	256	324	371
Average daily gain per steer ..... do	1.83	2.32	2.65
Total feed consumed per steer:			
Corn ..... do	1,127	1,690	2,254
Velvetbeans ..... do	744	744	744
Molasses ..... do	1,127	563	----------
Peanut straw ..... do	321	321	321
Minerals ..... do	11.9	9.6	11.3
Average ration:			
Corn ..... do	8.05	12.07	16.10
Velvetbeans ..... do	5.31	5.31	5.31
Molasses ..... do	8.05	4.02	----------
Peanut straw ..... do	2.29	2.29	2.29
Minerals ..... do	.09	.07	.08
Feed required per 100 pounds of gain:			
Corn ..... do	441	522	608
Velvetbeans ..... do	291	230	201
Molasses ..... do	441	174	----------
Peanut straw ..... do	125	99	87
Minerals ..... do	4.6	3.0	3.0
Value of feed per 100 pounds of gain ..... dollars	9.77	7.72	6.77
Initial cost per steer at $8.10 per 100 pounds of live weight ..... do	47.39	43.50	43.58
Cost of feed per steer ..... do	25.00	25.01	25.10
Total cost of steer at feed lot ..... do	72.39	68.51	68.68
Sale price per 100 pounds of live weight ..... do	8.94	9.80	9.93
Gross return per steer ..... do	75.19	84.38	90.26
Profit per steer ..... do	2.80	15.87	21.58
Average feeder grade	(1)	(1)	(1)
Average carcass grade	(2)	(2)	(3)
Average dressing percentage ..... percent	58.4	59.3	59.6

[1] Low Good.
[2] Average Good.
[3] High Good.

The group 1 steers returned $18.78 a head less profit than the group 3 steers and group 2 steers returned $5.71 a head less. The relatively low return made by group 1 was associated with a smaller average gain and low carcass grade, dressing percentage, and sale price per 100 pounds of live weight. The most important cause of the low return undoubtedly was the difference in nutritive value of corn and molasses. A less important factor was the high average initial cost per group 1 steer; another was the distinctly poor gain made by 1 steer in this group, the cause of which was not determined. The return from group 2 was lower than that from group 3 mainly on account of the smaller gain, resulting in an average carcass grade one-third lower than that of group 3, and partly on account of a slightly lower sale price per 100 pounds of live weight.

In this experiment the corn-molasses mixture in the ratio of 1:1 produced 69 percent as much gain as the corn alone, and the corn-molasses mixture in the ratio of 3:1 produced 87 percent as much.

EXPERIMENT 4 (1939–40)

The data pertaining to the fourth experiment are shown in table 5. In this experiment all groups consumed the same quantities of concentrates and roughage. The two groups receiving molasses made practically the same gains, but they averaged about 18 percent less

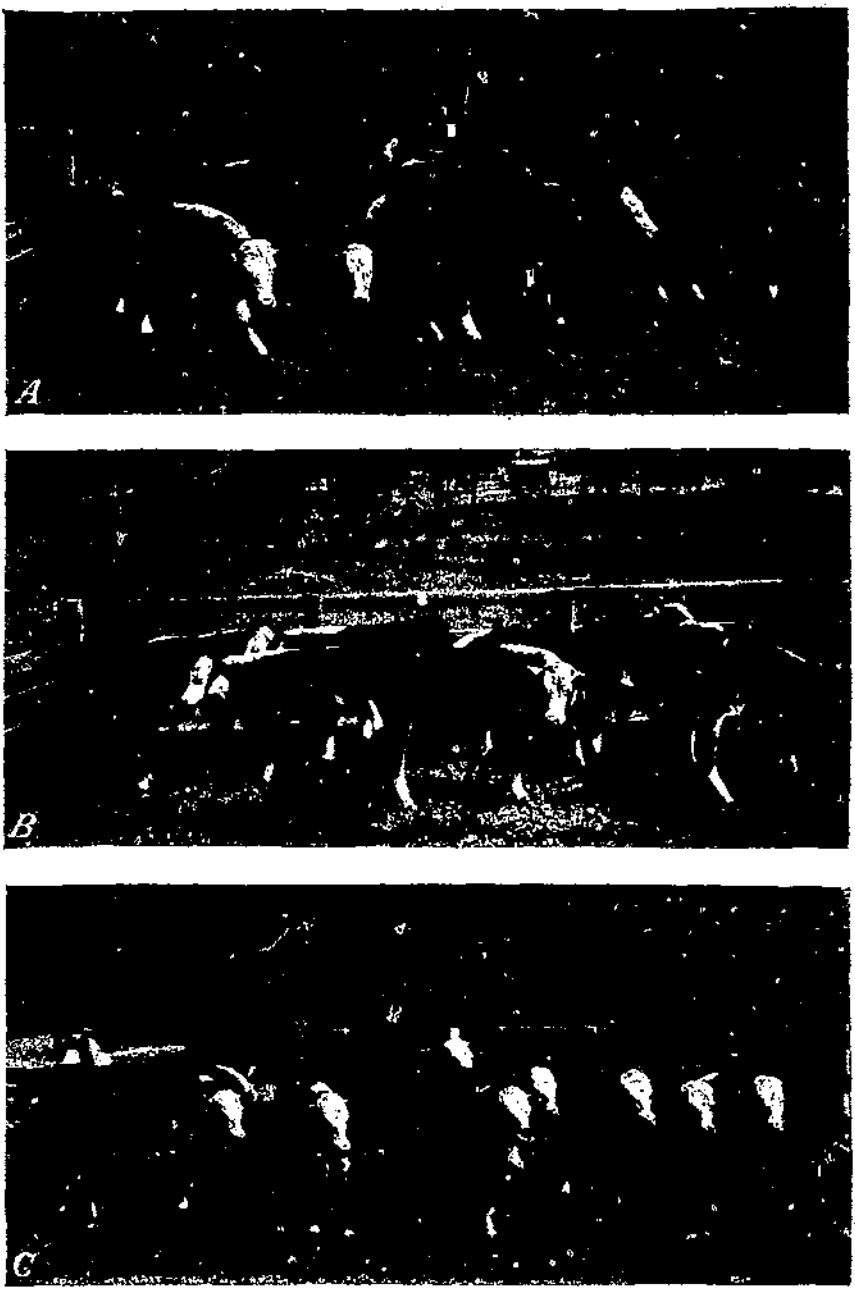

FIGURE 1.—*A*, Group 1 steers at end of 1938–39 experiment, fattened on a mixture of equal parts, by weight, of ground snapped corn and molasses, fed with velvetbeans and peanut straw; *B*, group 2 steers at end of 1938–39 experiment, fattened on a mixture of 3 parts, by weight, of ground snapped corn and 1 part of molasses, fed with velvetbeans and peanut straw; *C*, group 3 steers at end of 1938–39 experiment, fattened on ground snapped corn, velvetbeans, and peanut straw.

than those of group 3. However, gains of all groups were relatively low. Six of the steers in group 1, 7 in group 2, and 4 in group 3 made distinctly less favorable gains than the others in their respective groups, despite the fact that no feed was refused at any time during the experiment and inspection at the abattoir disclosed no abnormalities.

TABLE 5.—*Summary of fourth experiment, Nov. 1, 1939, to Mar. 20, 1940 (140 days)*

Item	Group 1, fed 1 part snapped corn to 1 part molasses, + velvetbeans and peanut straw	Group 2, fed 3 parts snapped corn to 1 part molasses, + velvetbeans and peanut straw	Group 3, fed *snapped* corn, velvetbeans, and peanut straw
Steers used ... number	15	15	15
Average initial weight at feed lot ... pounds	661	688	689
Average final weight at feed lot ... do	856	881	926
Average total gain per steer ... do	195	193	237
Average daily gain per steer ... do	1.39	1.38	1.69
Total feed consumed per steer:			
Corn ... do	1,050	1,576	2,101
Velvetbeans ... do	700	700	700
Molasses ... do	1,050	525	----------
Peanut straw ... do	373	373	373
Minerals ... do	10.4	10.8	9.5
Average ration:			
Corn ... do	7.50	11.25	15.01
Velvetbeans ... do	5.00	5.00	5.00
Molasses ... do	7.50	3.75	----------
Peanut straw ... do	2.66	2.66	2.66
Minerals ... do	.07	.08	.07
Feed required per 100 pounds of gain:			
Corn ... do	538	817	886
Velvetbeans ... do	359	363	295
Molasses ... do	538	272	----------
Peanut straw ... do	191	193	157
Minerals ... do	5.3	5.6	4.0
Value of feed per 100 pounds of gain ... dollars	14.95	14.94	12.02
Initial cost per steer at $8 per 100 pounds of live weight ... do	52.88	55.04	55.12
Cost of feed per steer ... do	29.15	28.84	28.49
Total cost of steer at feed lot ... do	82.03	83.88	83.61
Sale price per 100 pounds of live weight ... do	7.90	8.40	8.65
Gross return per steer ... do	67.62	74.00	80.10
Loss per steer ... do	14.41	9.88	3.51
Average feeder grade	(1)	(1)	(1)
Average carcass grade	(2)	(2)	(2)
Average dressing percentage ... percent	59.5	59.8	58.6

[1] Low Good. [2] Average Good. [3] High Good.

The average carcass grades of groups 1 and 2 were one-third of a grade lower than that of group 3. However, in dressing percentage group 2 averaged 1.2 percent higher than group 3, which was statistically significant. Differences in dressing percentage between groups 1 and 2 were not significant. In this experiment there were financial losses in all three groups. In groups 1 and 2 the losses were $10.90 and $6.37, respectively, a head more than in group 3, owing to the lower gains and selling prices and in a small degree to the $3.26 a ton higher cost of molasses than that of corn.

GENERAL DISCUSSION

In the first 3 of the 4 experiments, average daily gain per head was smallest in group 1, fed approximately equal quantities of corn and molasses, and largest in group 3, whose carbohydrate concentrate consisted only of corn. However, gains were not in direct proportion to the quantity of corn fed, for in the first year group 2 steers, fed corn

and molasses in a ratio of 3:1, gained practically as much as those in group 3, fed no molasses. In the fourth experiment group 1 gained fully as much as group 2 but materially less than group 3. In the fourth year all groups gained substantially less than comparable groups in the 3 preceding years. On an average for the 4 experiments (table 6), group 1 gained 81 percent as much as group 3, and group 2 gained 89 percent as much.

TABLE 6.—*Average results of the 4 experiments (188 days)*

Item		Group 1, fed 1 part snapped corn to 1 part molasses, +velvetbeans and peanut straw	Group 2, fed 3 parts snapped corn to 1 part molasses, +velvetbeans and peanut straw	Group 3, fed snapped corn, velvetbeans, and peanut straw
Steers used	number	51	51	51
Average initial weight at feed lot	pounds	613	610	617
Average gain in feed lot	do	243	267	299
Average ration:				
Corn	do	7.82	11.23	15.31
Velvetbeans	do	5.08	5.08	5.08
Molasses	do	7.46	4.00	----------
Peanut straw	do	3.62	3.47	2.79
Minerals	do	0.08	0.07	0.08
Feed required per 100 pounds of gain:				
Corn	do	428.0	660.0	631.0
Velvetbeans	do	278	253	226
Molasses	do	408	193	----------
Peanut straw	do	187	168	117
Minerals	do	4.5	3.6	3.4
Initial cost per feeder	dollars	47.32	47.13	47.60
Cost of feed per steer	do	27.96	27.80	27.60
Sale price per 100 pounds of live weight	do	8.42	8.76	8.97
Profit or loss per steer	do	−3.17	+1.83	+6.99

In the 4 years, for each 100 pounds of gain in live weight, group 1 steers ate 45 to 364 pounds, or an average of 207 pounds, more carbohydrate concentrates than group 3. In the first year, group 2 steers ate the same quantity of concentrates as group 3 for each 100 pounds of gain, but in the last 3 years their consumption of concentrates was 93 to 271 pounds, or an average of 105 pounds, more than group 3. However, cane molasses contains a considerable amount of water—frequently as much as 2½ times that in shelled corn, and consequently less nutrients than an equal weight of shelled corn.

However, in all 4 years, for each 100 pounds of gain in live weight, group 1 ate 34 to 136 pounds, or an average of 70 pounds, more peanut straw than group 3. Group 2 exceeded group 3 by 12 to 106 pounds, or an average of 51 pounds. In pounds of total digestible nutrients in the feed for each 100 pounds of gain in live weight calculated on the basis of the data representing the 4-year average, the steers in groups 1 and 2 consumed 18.6 and 10.5 percent, respectively, more than group 3.

The average sale price of the group 1 steers in the 4 experiments was 55 cents per hundredweight, or 6.1 percent, less than that of group 3, and that of the group 2 steers was 21 cents per hundredweight, or 2.3 percent, less. However, the loss per steer in group 1 and the small profit in group 2, in comparison with that in group 3, were due more to their smaller gains than to their slightly greater feed costs.

SUMMARY AND CONCLUSIONS

Experiments were carried on at Tifton, Ga., from 1937 to 1940, inclusive, to compare corn-molasses mixtures with corn, when fed with velvetbeans and peanut straw, for fattening steers. On the average, 38 head of grade Hereford steers about 18 months of age as feeders in the fall were used in each of the 4 experiments. The steers were fed 112 days in the first experiment but 140 days thereafter.

In each experiment the animals were divided as uniformly as possible into three groups and fed as follows: Group 1 received a mixture of corn and cane molasses in the ratio of 1 : 1 by weight; group 2, corn and cane molasses in the ratio of 3 : 1; and group 3, corn as the sole carbohydrate concentrate.

The steers were fed in open, well-drained lots, with fresh water, salt, and a mineral mixture available at all times. The mineral mixture consisted of equal parts by weight of bonemeal, ground limestone, and common salt.

In 3 of the 4 experiments group 2 gained more, had a higher dressing percentage, higher grade of carcass, higher sale price per 100 pounds of live weight, and yielded a more favorable financial return than group 1. In the first year only did group 2 excel group 3 in most of the items mentioned above.

When the only feed variable was the amount of molasses, and steer gains were favorable, as in the third experiment, the corn-molasses mixture in a ratio of 3 : 1 was about 25 percent more efficient in producing gain in live weight than the mixture in the ratio of 1 : 1. However, the former mixture was only about 85 percent as efficient as corn used as the sole carbohydrate concentrate in the ration. On the basis of average data for the 4 experiments, in terms of gain in live weight produced, the corn-molasses mixture in the ratio of 1 : 1 was approximately 80 percent as efficient as corn, whereas the mixture in the ratio of 3 : 1 was approximately 90 percent as efficient.

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