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Effect of
MOLASSES
AND MOLASSES FEED
on
QUALITY OF BEEF

By R. J. Webb
and
Sleeter Bull

Bulletin 510

UNIVERSITY OF ILLINOIS
AGRICULTURAL EXPERIMENT STATION

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OTHER ILLINOIS PUBLICATIONS ON FACTORS AFFECTING QUALITY OF BEEF

The experiment reported in this bulletin is part of a larger study which this Station is making of factors generally believed to affect the quality of beef. Other phases of the study have been published under the following titles:

Effects of Sex, Length of Feeding Period, and a Ration of Ear-Corn Silage on the Quality of Beef. By Sleeter Bull, Fred C. Olson, and John H. Longwell. Bul. 355. 1930.

Effect of Pasture on Grade of Beef. By Sleeter Bull, R. R. Snapp, and H. P. Rusk. Bul. 475. 1941.

Effect of Exercise on Quality of Beef. By Sleeter Bull and H. P. Rusk. Bul. 488. 1942.

Wartime Beef Production: What Grade of Feeders? What Finish? By Fred C. Francis, Sleeter Bull, and W. E. Carroll. Bul. 501. 1944.

Effect of Pregnancy on Quality of Beef. By R. R. Snapp and Sleeter Bull. Bul. 507. 1944.

Beef for the Table. By Sleeter Bull, R. J. Webb, and R. C. Ashby. Cir. 585. 1944.

Effect of Molasses and Molasses Feed On Quality of Beef

By R. J. WEBB and SLEETER BULL¹

MOLASSES and molasses feed in the beef-cattle ration have been shown by experiments to be inferior to corn from the standpoint of rate and economy of gains.² Yet some cattle feeders, especially the feeders of show cattle, claim that the generous feeding of molasses produces a more highly finished carcass and a brighter and firmer lean. Some packers, on the other hand, claim that molasses produces a soft underfinished carcass that cuts dark.

A recent experiment at the University of Illinois provided answers to many of the questions concerning the value of molasses and of molasses feed in the beef-cattle ration.

PLAN OF THE EXPERIMENT

Thirty choice yearling grade Hereford feeder steers were fed in three lots of 10 each for 150 days beginning April 14, 1937. The ration fed to each lot is listed below.

(1) Molasses, no grain

Cane molasses, full-fed, poured over 20 to 22 pounds of corn silage a head daily

1 pound soybean oilmeal to 5 pounds molasses

2 pounds whole alfalfa hay

$\frac{1}{10}$ pound limestone daily

(2) Molasses feed full-fed

200 pounds ground shelled corn

200 pounds ground oats

400 pounds cane molasses

150 pounds soybean oilmeal

200 pounds cut alfalfa

10 pounds limestone

10 pounds salt

20 pounds corn silage a head daily

} machine-mixed

(3) Corn

Shelled corn, full-fed

1 pound soybean oilmeal to 7 pounds corn

20 pounds corn silage a head daily

2 pounds whole alfalfa hay a head daily

$\frac{1}{10}$ pound limestone

¹R. J. WEBB, Superintendent, the Dixon Springs Experiment Station, and SLEETER BULL, Chief in Meats. ²Report of Tenth Annual Cattle Feeders' Meeting, Sept. 17, 1937 (*mimeo.*).

At the end of the feeding period the cattle were graded and sold on the Chicago market. After slaughter, the carcasses were graded, and a wholesale rib cut from each carcass was returned to the Station for further study. The wholesale rib cuts were graded by the investigators, using A. H. Form 353, Bureau of Animal Industry, U. S. Department of Agriculture. The 9th, 10th, and 11th rib cuts of each carcass were dissected, and the rib eyes were analyzed chemically for dry substance and fat.

The color of the rib eye at the 12th rib was measured with the spectrophotometer.¹

RESULTS

Rate and Economy of Gains

The results of the feeding experiment, together with shrinks during shipment to Chicago, and dressing percentages, are shown in Table 1. It will be noted that the average daily gain (2.1 pounds) of the steers that were fed molasses was considerably lower than the average gains (2.5 pounds daily) of those on molasses feed or those on corn. Furthermore to produce a hundred pounds of gain, the steers on molasses required 31 percent more concentrates (14 percent more dry substance), 28 percent more silage, and 20 percent more hay than the steers that were fed corn. The steers fed molasses feed required 3 percent less concentrates (7.6 percent less dry substance) than was required by the corn-fed steers, the same amount of silage, but 50 percent more hay.

Altho the costs of gains of the three lots were not greatly different, there was a marked difference in return above cost of cattle and feed. The steers in the corn lot reached a higher degree of finish and hence sold at a higher market price, \$18.25 a hundred. They made a return of \$69.35 a head over cost of cattle and feed. The molasses-feed lot sold for \$16.75 a hundred and showed a return of \$54.50 a head; and the molasses lot sold for \$16 a hundred and made a return of \$41.09 a steer.

No hog gain is credited to the lots that were fed molasses and molasses feed, because the rations fed to these two lots did not provide enough feed for hogs following cattle.

¹For a description of the method and the interpretation of the results see Ill. Agr. Exp. Sta. Bul. 355, pp. 219-225.

TABLE 1.—RATE AND ECONOMY OF GAINS, SHRINKS, DRESSING PERCENTAGES, SELLING PRICES, AND RETURNS

(10 steers per lot; all figures are averages)

	Molasses full-fed, no grain	Molasses feed full-fed	Corn full-fed
	<i>lb.</i>	<i>lb.</i>	<i>lb.</i>
Initial weight per steer	754	750	753
Final weight at Urbana	1 066	1 127	1 130
Daily gain	2.1	2.5	2.5
Final weight at Chicago	1 000	1 055	1 089
Shrink	66	72	41
Shrinkage, percent	6.2%	6.4%	3.6%
Feed eaten per day, first 60 days	<i>lb.</i>	<i>lb.</i>	<i>lb.</i>
Corn	.....	2.4 ^a	11.1
Oats	.....	2.4 ^a	.....
Molasses	10.9	4.6 ^a	.....
Soybean oilmeal	2.2	1.8 ^a	1.7
Total concentrates	13.1	11.2	12.8
Alfalfa hay	2.0	2.4 ^a	2.0
Corn silage	20.1	20.0	20.0
Feed eaten per day, last 90 days	.....	3.3 ^a	14.2
Corn	.....	3.3 ^a	.....
Oats	.....	6.8 ^a	.....
Molasses	15.0	2.5 ^a	2.0
Soybean oilmeal	3.0	15.9	16.2
Total concentrates	18.0	3.3 ^a	2.0
Alfalfa hay	2.0	20.0	20.0
Corn silage	22.0	.....	.....
Feed per hundredweight of gain	.....	121 ^a	516
Corn	.....	121 ^a	.....
Oats	.....	241 ^a	.....
Molasses	642	90 ^a	74
Soybean oilmeal	129	573 ^a	590
Total concentrates	771	796	796
Corn silage	1 021	120 ^a	80
Alfalfa hay	96	.....	.....
Feed cost per hundredweight of gain ^b	\$ 14.85	\$ 13.25	\$ 15.09
Cost per steer in lots at \$9.10 per hundredweight	\$ 68.61	\$ 68.25	\$ 68.55
Feed cost per steer	46.30	49.96	56.84
Cost of cattle and feed	114.91	118.21	125.39
Selling price per hundredweight	\$ 16.00	\$ 16.75	\$ 18.25
Average return above cost of cattle and feed	41.09	54.50	69.35
Dressing percentages			
Based on Chicago live weights	62.4%	61.9%	62.9%
Based on Urbana live weights	58.6%	57.9%	60.7%
Hog gains per steer	<i>lb.</i>	<i>lb.</i>	<i>lb.</i>
	None	None	30.5

^aComputed from the percentage in the mixture which was fed.^bFeed prices used in calculations were: corn, \$1.12 a bushel; oats, 40 cents a bushel; molasses, \$25 a ton; soybean oilmeal, \$45 a ton; alfalfa hay, \$15 a ton; silage, \$6.25 a ton; grinding corn, 8 cents a hundredweight; grinding oats, 9 cents a hundredweight; grinding alfalfa, \$2.50 a ton; mixing molasses feed, 5 cents a hundredweight. The total cost of grinding and mixing the molasses feed was \$2.90 a ton.

Dressing Percentages

The dressing percentages are figured in two ways: (1) on the Chicago live weights, with a 2-percent shrink on the hot-carcass weight; and (2) on the Urbana live weights, with a 2-percent shrink on the hot-carcass weight. Figured on the Chicago live weights, the dressing percentages were not significantly different. The corn steers dressed 62.9

percent; the molasses-feed steers, 61.9 percent; and the molasses steers, 62.4 percent. The shrinks of the three lots were: molasses lot, 6.2 percent; molasses-feed lot, 6.4 percent; and corn lot, 3.6.

Figured on the home live weights, the molasses lot dressed 58.6 percent; the molasses-feed lot, 57.9 percent; and the corn lot, 60.7 percent. The difference in favor of the corn lot is significant and is due to less shrink in shipment.

Grades of Slaughter Steers and of Carcasses

The individual Chicago live weights, live grades, and carcass grades of the steers are given in Table 2. The corn steers graded considerably higher than the molasses-feed steers; the molasses steers graded lowest. A summary of the live grades follows:

	Prime	Choice+	Choice	Choice-	Good+	Good	Good-
Corn steers.	1	2	5	..	2	..	..
Molasses-feed steers ..	..	..	3	4	1	..	2
Molasses steers. . . . .	..	..	1	1	6	1	1

The carcass grades of the corn steers were highest, as was expected judging from the live grades; the grades of the molasses-feed steers were next; and those of the molasses steers were lowest. The differences among the three lots were largely due to differences in degree of finish. There were no noticeable differences in conformation and quality. A summary of carcass grades follows:

	Prime	Choice+	Choice	Choice-	Good+	Good	Good-
Corn carcasses.	1	2	4	1	2	..	..
Molasses-feed carcasses. . . . .	..	..	3	4	1	..	2
Molasses carcasses. . . . .	..	..	1	1	6	1	1

Market Grades of Ribs

The grades of the wholesale rib cuts and descriptions of their texture of lean, marbling, color of fat, firmness of fat, and firmness of lean are given in Table 3. The ribs of the corn lot graded highest. The ribs of the molasses-feed lot graded relatively higher than the carcasses, being almost as good as the corn ribs. The molasses ribs graded distinctly lower than the ribs of the other lots. A summary of the market grades of ribs follows:

	Choice+	Choice	Choice-	Good+	Good	Good-	Medium
Corn ribs.	2	3	3	2	..	..	..
Molasses-feed ribs.	2	3	2	1	1	1	..
Molasses ribs. . . . .	..	1	3	2	2	1	1

TABLE 2.—LIVE AND CARCASS GRADES

Steer	Live weight	Live grade	Carcass grade
Molasses lot			
	<i>lb.</i>		
131.....	1 067	Good+	Choice-
132.....	993	Good+	Good+
133.....	1 027	Good	Good+
134.....	1 027	Good+	Good+
135.....	953	Good+	Good+
136.....	893	Good+	Good-
137.....	1 063	Choice	Good+
138.....	953	Good-	Good
139.....	1 027	Good+	Good+
140.....	1 013	Choice-	Choice
Molasses-feed lot			
121.....	1 061	Good-	Choice-
122.....	1 061	Good+	Choice-
123.....	1 081	Choice-	Choice
124.....	921	Good-	Good-
125.....	1 011	Choice-	Choice-
126.....	1 181	Choice-	Choice-
127.....	961	Choice-	Good+
128.....	1 091	Choice	Choice
129.....	1 161	Choice	Choice
130.....	1 021	Choice	Good-
Corn lot			
141.....	1 135	Choice+	Choice
142.....	1 056	Good+	Good+
143.....	1 026	Choice	Choice+
144.....	1 125	Choice+	Prime-
145.....	1 077	Good+	Choice-
146.....	1 135	Choice	Choice
147.....	1 225	Prime-	Choice+
148.....	997	Choice	Choice
149.....	1 097	Choice	Choice
150.....	1 017	Choice	Good+

Fat in Ribs

Since the fat content of the 9th, 10th, and 11th ribs is a fairly accurate measure of the relative finish of the carcass, these ribs were separated with a knife into lean, fat, bone, and tendon. The percentages of fat are given in Table 3.

The ribs of the molasses carcasses contained an average of 32.6 percent of fat—considerably less than was contained in the rib cuts of the other carcasses. The fat content of the ribs of the molasses-feed carcasses averaged 36.8 percent and of the corn carcasses, 35.8 percent. The difference between these two latter lots is insignificant.

Texture of Lean of Rib Eyes

Differences in rations did not affect texture of lean. All but two of the rib eyes were graded "fine." The two exceptions were one from the molasses lot and one from the corn lot, both "slightly coarse" in texture.

TABLE 3.—QUALITY OF RIBS

Steer	Grade	Fat in ribs ^a	Texture of lean	Marbling	Fat in rib eyes ^b	Color of fat	Firmness of fat	Firmness of lean	Dry substance in rib eyes ^c
Molasses lot									
131.....	Choice—	36.8	Fine	Moderate	4.8	Creamy white	Firm	Medium firm	28.1
132.....	Good+	31.5	Fine	Traces	2.9	Creamy white	Firm	Soft	28.4
133.....	Choice—	31.7	Fine	Moderate	5.1	Creamy white	Firm	Medium firm	26.6
134.....	Good+	28.2	Sl. coarse	Moderate	4.0	Creamy white	Firm	Medium firm	28.0
135.....	Good—	31.2	Fine	Traces	3.4	Creamy white	Firm	Very soft	27.3
136.....	Good—	29.3	Fine	Moderate	3.6	Creamy white	Medium firm	Soft	27.0
137.....	Choice—	39.3	Fine	Moderate	5.0	Slightly yellow	Firm	Soft	27.8
138.....	Medium	24.3	Fine	Traces	3.0	Creamy white	Medium firm	Very soft	27.3
139.....	Good	34.8	Fine	Traces	2.8	Creamy white	Very firm	Soft	26.3
140.....	Choice	39.0	Fine	Moderate	6.3	Creamy white	Very firm	Medium firm	30.9
Average.....		32.6			4.1				27.8
Molasses-fed lot									
121.....	Choice—	37.5	Fine	Moderate	3.8	Creamy white	Firm	Medium firm	26.7
122.....	Choice	37.7	Fine	Plentiful	5.7	Creamy white	Firm	Firm	28.8
123.....	Choice	40.2	Fine	Plentiful	4.5	Creamy white	Very firm	Firm	28.7
124.....	Good—	26.0	Fine	Traces	2.6	Creamy white	Soft	Very soft	24.3
125.....	Good+	39.3	Fine	Moderate	2.0	Creamy white	Firm	Medium firm	25.1
126.....	Choice+	38.3	Fine	Plentiful	4.6	Creamy white	Very firm	Very firm	27.6
127.....	Good	30.2	Fine	Traces	3.2	Creamy white	Very firm	Soft	26.0
128.....	Choice	38.0	Fine	Plentiful	4.8	Creamy white	Very firm	Firm	29.1
129.....	Choice+	41.1	Fine	Plentiful	4.7	Creamy white	Very firm	Very firm	29.2
130.....	Choice—	39.3	Fine	Moderate	5.1	Creamy white	Firm	Firm	29.0
Average.....		36.8			4.1				27.5
Corn lot									
141.....	Choice—	37.0	Fine	Moderate	3.7	Creamy white	Very firm	Firm	28.3
142.....	Good+	30.7	Fine	Moderate	4.4	Creamy white	Firm	Medium firm	26.9
143.....	Choice—	42.9	Fine	Moderate	4.0	Creamy white	Firm	Medium firm	27.7
144.....	Choice+	40.7	Fine	Moderate	5.3	Creamy white	Very firm	Medium firm	26.9
145.....	Choice—	31.2	Fine	Moderate	3.1	Creamy white	Firm	Firm	27.1
146.....	Choice—	33.7	Fine	Moderate	3.5	Creamy white	Very firm	Medium firm	29.9
147.....	Choice	38.4	Fine	Plentiful	4.0	Creamy white	Very firm	Medium firm	27.6
148.....	Choice	38.3	Fine	Moderate	3.7	Creamy white	Very firm	Medium firm	29.4
149.....	Choice+	35.7	Fine	Abundant	7.1	Creamy white	Very firm	Very firm	31.2
150.....	Good+	31.8	Sl. coarse	Moderate	2.0	Creamy white	Firm	Medium firm	25.2
Average.....		35.8			4.2				28.0

^a9th, 10th, and 11th ribs.

Marbling of the Rib Eyes

According to the graders, the ribs from the corn lot and from the molasses-feed lot were about equal in marbling (Table 3). Of the molasses-feed lot, 5 had plentiful marbling, 3 had moderate amounts, and 2 had only traces. Of the corn lot, 1 had abundant marbling; 1, plentiful; and 8, moderate amounts. The ribs of the molasses lot had distinctly less marbling; 6 were moderately well marbled and 4 had only traces.

As a check on the amounts of marbling as observed by the graders, the percentages of fat (Table 3) in the rib eyes of the 9th, 10th, and 11th ribs were determined chemically. There was little correlation between the amounts of marbling as noted by the graders and the amounts of fat in the rib eyes as determined by the chemists. Chemical analysis showed the average fat content of the three lots to be practically the same.

Firmness and Color of Fat

The corn ribs had the firmest fat. Six were very firm and 4 were firm. Of the molasses-feed ribs, 5 were very firm, 4 were firm, and 1 was soft. Of the molasses ribs, 2 were very firm, 6 were firm, and 2 were medium firm.

Differences in rations had no effect on color of fat. One carcass from the molasses lot had slightly yellow fat. The fat of all other carcasses was creamy white.

Firmness of Lean

According to the graders, the corn ribs had also the firmest lean; the molasses-feed ribs were next; and the molasses ribs were much the softest. The ribs of the three lots were graded as follows on firmness of lean. Corn: 1, very firm; 2, firm; and 7, medium firm. Molasses-feed: 2, very firm; 4, firm; 2, medium firm; 1, soft, and 1, very soft. Molasses: 4, medium firm; 3, soft; and 3, very soft.

The percentages of dry substance in the rib eyes as determined chemically (see Table 3) showed no significant differences due to ration. There were only slight correlations between the degree of firmness as noted by the graders and the percentage of dry substance as determined chemically.

Color of Lean

Color measurements of the lean of the rib eyes are given in Table 4. Little difference was shown in the desirability of the colors of the molasses ribs and of the corn ribs. One molasses rib, No. 136, was decidedly off-color being medium-dark purple. Another, No. 137, was medium-dark red. Of the corn ribs, No. 148 was medium-dark purple and No. 150 was medium-light purple. The other ribs of these two lots were excellent in color, being a bright red.

The ribs of five of the molasses-feed steers were decidedly off-color. One, No. 123, was dark purple; four—Nos. 125, 126, 129, and 130—were medium-dark purple; and one, No. 128, was medium-dark red. The others were bright red. Since the ribs from the steers receiv-

TABLE 4.—COLOR OF RIB EYES

Steer	Brightness	Dominant wave length	Purity
Molasses lot			
	<i>perct.</i>	<i>mμ.</i>	<i>perct.</i>
131.....	13.9	620	13
132.....	13.9	642	10
133.....	13.7	660	16
134.....	12.7	610	13
135.....	13.2	620	12
136.....	12.1	494C	15
137.....	11.8	700	15
138.....	14.1	607	21
139.....	14.1	617	8
140.....	14.6	610	19
Average.....	13.4		
Molasses-feed lot			
121.....	15.4	615	16
122.....	14.1	607	20
123.....	9.0	493C	7
124.....	13.7	605	22
125.....	11.4	495C	12
126.....	12.0	493C	13
127.....	12.4	606	17
128.....	12.9	700	14
129.....	12.2	495C	13
130.....	12.0	495C	13
Average.....	12.5		
Corn lot			
141.....	13.3	645	5
142.....	15.6	617	12
143.....	13.4	640	10
144.....	14.2	616	12
145.....	14.6	617	12
146.....	13.7	627	11
147.....	13.8	622	10
148.....	11.6	494C	15
149.....	14.5	605	21
150.....	12.7	493C	15
Average.....	13.7		

ing molasses and no grain had good colors, with one exception, it seems unlikely that the poor colors in the molasses-feed ribs were due to the comparatively small amount of molasses in the ration.

SUMMARY

Thirty choice yearling grade Hereford steers were full-fed in three lots of 10 each for 150 days as follows: (1) blackstrap molasses, soybean oilmeal, corn silage, and alfalfa hay; (2) molasses feed, consisting of a mixture of corn, oats, molasses, soybean oilmeal, cut alfalfa hay, and corn silage; and (3) shelled corn, soybean oilmeal, corn silage, and alfalfa hay.

Rate and economy of gains. The average daily gains of the three lots were as follows: (1) molasses, 2.1 pounds; (2) molasses-feed, 2.5 pounds; (3) corn, 2.5 pounds.

To produce 100 pounds of gain the molasses steers required 31 percent more concentrates (14 percent more on the dry basis), 28 percent more silage, and 20 percent more hay than the corn steers. The molasses-feed steers required 3 percent less concentrates (7.6 percent less on the dry basis) than was required by the corn, the same amount of silage, but 50 percent more hay.

Altho the differences in feed costs were small, the corn lot sold for \$18.25 a hundred and made a return of \$69.35 a head over the cost of the cattle and feed; the molasses-feed lot sold for \$16.75 a hundred and showed a return of \$54.50 a head; and the molasses lot sold for \$16.00 a hundred and made a return of \$41.09.

Grades and dressing percentages. The live grades of the corn lot (1 Prime-, 2 Choice+, 5 Choice, and 2 Good+) were higher than those of the molasses-feed lot (3 Choice, 4 Choice-, 1 Good+, and 2 Good-). The molasses lot graded lowest (1 Choice, 1 Choice-, 6 Good+, 1 Good, and 1 Good-).

The dressing percentages of the three lots (*see page 489*), as figured on the Chicago live weights, were not significantly different. As figured on the home live weights, there was a significant difference in favor of the corn lot.

The corn-carcass grades (1 Prime-, 2 Choice+, 4 Choice, 1 Choice-, and 2 Good+) were higher than those of the molasses-feed carcasses (3 Choice, 4 Choice-, 1 Good+, and 2 Good-). The molasses carcasses graded lowest (1 Choice, 1 Choice-, 6 Good+, 1 Good, and 1 Good-). The differences in carcass grades were due

largely to differences in finish. This observation of the graders was verified by a physical determination of the fat content of the 9th, 10th, and 11th ribs.

The molasses-feed ribs were graded almost as high as the corn ribs. The molasses ribs graded distinctly lower.

Quality of fat and lean. In texture of lean and color of fat there were no differences due to rations.

The rib eyes of the corn carcasses and the molasses-feed carcasses were about equal in marbling and were considerably better than those of the molasses lot.

The corn ribs had the firmest fat and lean, the molasses-feed ribs were next, and the molasses ribs were last. In fact the lean of the molasses ribs was distinctly inferior, ranging from very soft to medium firm.

Eight rib eyes of the corn lot and eight of the molasses lot had excellent color. Five of the molasses-feed ribs were poor in color, ranging from medium to dark purple; one was medium-dark red. Off-color was not attributed to the molasses in the ration.

CONCLUSIONS

In the ration of fattening yearling steers, the substitution of molasses for all the corn reduces the rate of gain and increases the amounts of concentrates and roughage to produce 100 pounds of gain. It also reduces considerably the market grade of the slaughter cattle, increases the shrink, decreases the dressing percentage, and lowers the market grade of the carcasses about one-third to two-thirds of a grade.

The substitution of molasses feed for corn, soybean oilmeal, and alfalfa hay has no effect on the rate of gain or the amounts of concentrates and silage to produce 100 pounds of gain, but does increase the hay requirement 50 percent. It lowers the market grade of the cattle, increases the shrink, decreases the dressing percentage, and lowers the market grade of the carcasses about one-third of a grade. (The molasses feed used in this experiment consisted of cane molasses 40 parts, ground corn 20 parts, ground oats 20 parts, soybean oilmeal 15 parts, cut alfalfa 20 parts, limestone 1 part, and salt 1 part.)







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