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Abstract
Eighty Angus x Hereford cross steers were used in an individual feeding study to compare soybean molasses (a by-product of soybean meal manufacture) and soybean meal as ingredients in finishing diets containing flaked corn or a combination of high-moisture corn and dryrolled corn. Supplementation with soy molasses resulted in higher (P<.05) feed intakes in the cattle fed the high-moisture corn diet but had no effect on intakes of cattle fed the flaked diets. No such changes were noted for supplementation with soybean meal. In general, carcass traits were not influenced by level or type of supplement. Soy molasses appears to have feed value equal to or greater than that of soybean meal when compared on a protein basis. Its value as a source of supplemental nutrients appears to be greater in steam-flaked diets than in high-moisture diets.

Keywords
Cattlemen's Day, 1999; Kansas Agricultural Experiment Station contribution; no. 99-339-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 831; Beef; Soy molasses; Degradable intake protein; Finishing cattle

SOY MOLASSES AS A FEED INGREDIENT FOR FINISHING CATTLE

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Summary

Eighty Angus × Hereford cross steers were used in an individual feeding study to compare soybean molasses (a by-product of soybean meal manufacture) and soybean meal as ingredients in finishing diets containing flaked corn or a combination of high-moisture corn and dry-rolled corn. Supplementation with soy molasses resulted in higher (P<.05) feed intakes in the cattle fed the high-moisture corn diet but had no effect on intakes of cattle fed the flaked diets. No such changes were noted for supplementation with soybean meal. In general, carcass traits were not influenced by level or type of supplement. Soy molasses appears to have feed value equal to or greater than that of soybean meal when compared on a protein basis. Its value as a source of supplemental nutrients appears to be greater in steam-flaked diets than in high-moisture diets.

(Key Words: Soy Molasses, Degradable Intake Protein, Finishing Cattle.)

Introduction

Isolation of protein from defatted soy flakes results in the production of soy molasses, which is a waste stream composed largely of mono-, di- and trisaccharides, as well as protein and potentially valuable mineral nutrients. Disposal of this waste stream is costly and represents a lost opportunity because of its potential value as a feed ingredient for livestock.

Cereal grains typically are deficient in rumen degradable intake protein (DIP), thus requiring the addition of large amounts of urea and(or) natural proteins as sources of nitrogen and pre-formed protein in order to maximize performance of finishing cattle. Soybean meal is a common source of protein in finishing cattle diets because of its high rumen degradability and relatively low cost. Numerous studies have evaluated responses to soybean meal in finishing diets, and the responses naturally are attributed to its protein. Unfortunately, this disregards the possibility that other components constituting about half of the soybean meal may be stimulating digestion and/or animal growth. We feel that the carbohydrate fraction of soybean meal may stimulate ruminal digestion.

Experimental Procedures

Grain Processing. Early harvest corn (26% moisture) was processed through a roller mill and subsequently packed into plastic AgBags® for ensiling. Dry rolled corn was processed to a mean geometric particle size of approximately 3,800 microns. Whole shelled corn was processed daily into flakes by steam conditioning for approximately 40 to 45 minutes and then flaking through corrugated rolls to a density of approximately 26 lb/bushel.

Cattle Performance Trial. Eighty Hereford-Angus steers (850 lb) were adapted to a common dry rolled corn (85% concentrate) diet prior to initiating the experiment, in order to equalize gastrointestinal fill. Animals were stratified by initial weight and allotted randomly within strata to 10 experimental treatments, with a total of eight animals per treatment combination. Cattle were implanted with Revalor®-S and treated for internal and external parasites. Steers were stepped up to final finishing diets containing 10% sorghum silage (dry basis) over a period of 10 days.

Compositions and actual protein content of the experimental rations are shown in Table 1. Cattle were fed diets containing either steam-flaked corn or a 70:30 mixture of high-moisture corn and dry-rolled corn. Additionally, diets were supplemented with 2 or 4% (dry basis) soybean meal (49.1% protein) or soybean molasses (20.9% protein; 62.1% carbohydrate). Cattle were placed into individual feeding pens (110 ft^2) and fed their respective diets once daily ad libitum. Unconsumed feed was collected, weighed, and analyzed weekly for dry matter content.

Final weights were determined as shrunk weights taken on the day of slaughter (gross weight less 4%) and as carcass weight divided by a common dressing percentage (63.85%). Ribeye area, fat thickness, percentage KPH fat, marbling score, incidence of dark cutters, and USDA quality and yield grades were evaluated 24 hours after slaughter. The experiment was conducted as a randomized complete-block design with eight replicates of 10 treatments. Individual animal was the experimental unit.

Results and Discussion

Performance for the 107-day finishing experiment is summarized in Tables 2 and 3. Carcass-adjusted daily gains and feed efficiencies were similar for cattle fed steam-flaked corn and the high-moisture/dry-rolled corn combination (P>.2). Cattle fed the high-moisture diet tended (P=.07) to have greater dry matter intakes. The percentage of carcasses grading USDA Choice or better was similar for cattle fed flaked-corn diets and high-moisture/dry-rolled corn combinations, but most carcasses graded Choice, so there was little room for improvement.

Interactions between grain type and supplement type were not apparent (Table 2). The soy molasses yielded improvements in gain and efficiency (carcass adjusted) that were comparable to those with soybean meal. Coefficients obtained through regression analyses (Table 3) suggest that the growth responses observed may have been consistent with the level of degradable protein provided by each supplement. The response to supplemental protein was approximately 2½ times greater for cattle fed flaked corn than for those fed the high-moisture/dry-rolled combination. This may have been the result of lower ruminal degradability of protein in steam-flaked grain compared to high-moisture grain, thus providing for a greater response to supplemental degradable protein. Based on results of our study, nonprotein components of soybean meal and soy molasses may contribute to efficiency improvements. However, regression estimates (Table 3) could be interpreted to suggest that supplemental protein in the form of soy molasses is more readily available than that of soybean meal. This was confirmed by laboratory *in vitro* measurements in which soy molasses supported 55% greater microbial growth under nitrogen-limiting conditions than soybean meal.

Supplementation with soy molasses resulted in higher (P<.05) feed intakes in the cattle fed the high-moisture corn diet, but had no effect on intakes of cattle fed the flaked diets. No such changes were noted when the supplement was soybean meal. Dressing percentages were improved (P<.01) in cattle fed the steam-flaked diet as the level of soy molasses was increased. Other carcass traits were not influenced by level or type of supplement. Given the high percentage of carcasses grading USDA Choice or Prime, there obviously was little room for improvement of carcass quality.

In summary, soy molasses appears to have feed value equal to or greater than that of soybean meal when compared on a protein basis. Its value as a source of supplemental nutrients appears to be greater in steam-flaked than in high-moisture corn diets.

Table 1. Compositions of Diets (Dry Matter Basis)[1]

	Steam-Flaked Corn					High-Moisture:Dry-Rolled Corn[3]				
Ingredients	Control	SM2	SM4	SBM2	SBM4	Control	SM2	SM4	SBM2	SBM
Corn	84.18	82.50	80.81	82.29	80.41	84.17	82.50	80.81	82.29	80.40
Sorghum silage	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Tallow	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Soy molasses	-	2.00	4.00	-	-	-	2.00	4.00	-	-
Soybean meal	-	-	-	2.00	4.00	-	-	-	2.00	4.00
Urea	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Limestone	1.60	1.52	1.45	1.61	1.61	1.60	1.52	1.45	1.61	1.61
Sodium chloride	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Potassium chloride	0.40	0.21	0.02	0.32	0.24	0.40	0.21	0.02	0.32	0.24
Ammonium sulfate	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Calcium phosphate	0.16	0.11	0.06	0.12	0.08	0.16	0.11	0.06	0.12	0.08
Vit./TM premix[2]	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Actual crude protein,	10.94	11.27	11.59	11.84	12.73	11.08	11.41	11.73	11.99	12.89

[1]SM2: 2% soybean molasses, SM4:4% soybean molasses, SBM2: 2% soybean meal, and SBM4: 4% soybean meal.

[2]Vit./ TM premix formulated to provide (total diet dry matter): 1.2 KIU/lb vitamin A, 15 IU/lb vitamin E, 0.05 ppm cobalt, 10 ppm copper, 0.60 ppm iodine, 60 ppm manganese, 0.25 ppm selenium, 60 ppm zinc, 30 g/ton Rumensin®, and 10 g/ton Tylan®.

[3]High-moisture corn (70%), dry-rolled corn (30%) mixture.

Table 2. Least-Squares Means for Performance of Finishing Cattle

	Steam-Flaked Corn					High-Moisture:Dry-Rolled Corn					
Item	Control	SM2	SM4	SBM2	SBM4	Control	SM2	SM4	SBM2	SBM4	SEM
DMI, lb/d[a]	21.8	21.1	21.3	20.9	21.1	20.5	22.8	23.0	22.4	21.8	.72
ADG, lb/d	2.86	2.81	2.81	2.77	3.24	2.44	2.78	3.11	2.79	2.83	.22
F:G lb/lb[b,c]	7.56	7.50	7.54	7.43	6.47	8.33	8.14	7.34	7.96	7.61	.28
Carcass adjusted[2] ADG, lb/day	2.58	2.99	2.91	2.64	3.21	2.52	2.84	3.04	2.87	2.94	.22
Carcass adjusted[2]	8.48	7.08	7.33	7.83	6.53	8.07	7.98	7.51	7.72	7.37	.48

[1]SM2: 2% soybean molasses, SM4:4% soybean molasses, SBM2: 2% soybean meal, and SBM4: 4% soybean meal.

[2]Calculated by estimating final live weight as carcass weight divided by a common dressing percentage of 63.85%.

[a]Grain processing effect (P<.10).

[b]Grain processing effect (P<.05).

[c]Supplement effect (P=.11).

Table 3. Regression Coefficients for Performance of Finishing Cattle

	Soybean Meal				Soy Molasses			
	Flaked Corn		High-Moisture Corn/ Dry-Rolled Corn (70:30)		Flaked Corn		High-Moisture Corn/ Dry-Rolled Corn (70:30)	
Item	Intercept	Change per 1% Added Soybean Meal	Intercept	Change per 1% Added Soybean Meal	Intercept	Change per 1% Added Soy Molasses	Intercept	Change per 1% Added Soy Molasses
G:F[a]	.1154	.0088[b]	.1239	.0030	.1221	.0046	.1229	.0023
DMI, lb	21.58	-.1629	20.89	.3542	21.63	.6191[b]	20.83	-.104
ADG, lb[a]	2.49	.157[b]	2.56	.111	2.65	.083	2.54	.132

[1]SM2: 2% soybean molasses, SM4:4% soybean molasses, SBM2: 2% soybean meal, and SBM4: 4% soybean meal.

[a]Based on carcass weights and adjusted to a common dressing percentage of 63.85%.

[b]Slope is different from zero (P<.05).

Table 4. Carcass Characteristics

	Steam-Flaked Corn					High-Moisture:Dry-Rolled Corn					
Item	Control	SM2	SM4	SBM2	SBM4	Control	SM2	SM4	SBM2	SBM4	SEM
Dressing percent[a]	62.1	64.8	64.4	63.1	63.7	64.3	64.2	63.4	64.3	64.4	.59
HCW, lbs	744	776	771	754	783	737	770	778	770	767	17.09
Ribeye area, sq. in.	12.51	12.65	12.65	12.89	13.37	12.30	13.43	13.13	13.64	12.45	.05
Kidney, pelvic heart fat, %[b]	2.56	2.24	2.50	2.50	2.63	2.69	2.50	2.69	2.63	2.72	.42
Backfat, in	.63	.67	.62	.54	.58	.59	.56	.54	.57	.67	.05
USDA yield grade	3.13	3.02	3.13	2.88	3.00	3.00	3.00	3.00	3.25	3.01	.13
USDA quality grade[2]	3.88	3.87	4.00	4.00	4.00	3.88	3.88	4.00	3.88	3.70	.12
Liver abscess, %	12.5	15.3	0	0	0	12.5	0	0	0	.1	6.9
Percent choice	87.5	86.8	100.0	100.0	100.0	87.5	87.5	100.0	87.5	85.3	9.8

[1]SM2: 2%soybean molasses, SM4:4% soybean molasses, SBM2: 2% soybean meal, and SBM4: 4% soybean meal.

[2]USDA quality grade 3 = select, 4 = choice.

[a]Grain processing x supplement interaction (P<.10).

[b]Effect of grain processing (P<.10).