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Effect of fat source on performance and carcass quality of finishing steers

Robert T. Brandt Jr.

Effect of Fat Source on Performance and Carcass Quality of Finishing Steers[1]

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Summary

Two trials that utilized 356 steers were conducted to evaluate the effects of various fat sources (3.5% of ration dry matter) on performance and carcass traits of finishing cattle fed flaked milo diets. In trial 1, soybean oil, bleachable tallow, and yellow grease (blend of tallow and restaurant grease) were compared to a nonfat control. Feeding fat increased (P<.05) daily gain, feed efficiency, carcass weight, and dressing percent of steers. Soybean oil and yellow grease also tended to increase 12th rib backfat thickness and marbling. Feed costs of gain were improved only by yellow grease. However, when increased carcass yield and quality were considered, there was a significant economic return from all fat sources. In trial 2, fat treatments were acidulated soybean soapstock (SBSS), tallow, a blend of 70% SBSS:30% tallow, and yellow grease. Feeding tallow or the SBSS: tallow blend improved (P<.05) feed efficiency by 7.7% compared to the nonfat control. Pooled across source, feeding fat increased (P<.10) backfat thickness and marbling. Compared to the control, feed cost of gain was reduced 6 cents/lb by the SBSS:tallow blend. However, when increased carcass value was accounted for, net returns of $3.50 to $6.00 per head were seen for SBSS, tallow, and SBSS:tallow priced at 13, 17, and 13 cents per lb, respectively. The SBSS:tallow blend provided greater performance than was predicted by observed performance of steers fed SBSS or tallow separately, an indication of associative response. In trial 2, intake and gain were lowest for yellow grease, resulting in a negative economic return,which isin complete disagreement with results obtained in trial 1.

Introduction

Much confusion exists concerning the feeding value of various fat sources available to Kansas feedyards. The composition of blended fats varies considerably with the availability and price of components of the blend. The Southwest Branch Station is determining the effect of fat sources varying in origin (plant vs animal) and degree of saturation on finishing performance, carcass quality, and fatty acid composition of depot fat. This paper will discuss feeding results obtained to date.

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[1]Appreciation is expressed to National Byproducts, Inc., Wichita, KS, and Western America Feed Fat, Inc., Douglasville, TX for supplying fats used in this research.

[2]Southwest Kansas Experiment Station, Garden City.

Composition of Feed Fats. Typical analyses of some common fats are presented in the Table 30.1. Estimates of 1986 production are included for comparative purposes. Fatty acid proportions vary considerably among fat sources, particularly for ratios of unsaturated to saturated fatty acids. Whether feeding a high amount of unsaturated fatty acids will impact carcass fat composition is unknown, although it is generally (and probably incorrectly) assumed that through ruminal fermentation, almost all di- and tri-glycerides are hydrolyzed and the unsaturated fatty acids are hydrogenated. However, values published by the Meat Board show that less than 50% of the fatty acids in beef fat are saturated. Therefore, carcass fat composition may potentially be altered by feeding highly unsaturated fat sources, increasing ruminal fat bypass through formation of calcium or potassium soaps, or otherwise protecting fatty acids. Of particular interest in this regard are linoleic and linolenic acids, implicated recently in the reduction of high blood pressure and incidence of heart disease. Vegetable oils and soapstocks are rich sources of these fatty acids.

Table 30.1. Fatty acid composition of commercial fat sources

	Oil or Fat				
Item	Soybean	Tallow	Yellow Grease	Lard	Poultry
1986 production, mill. lbs	11,880	5,333	1,678	816	300
Fatty acids, %					
Myristic (C14)		2.0	1.0	1.5	2.0
Palmitic (C16)	11.5	30.0	26.0	27.0	21.0
Palmitoleic (C16:1)		3.5	4.0	3.0	8.0
Stearic (C18)	4.0	19.0	12.5	13.0	6.0
Oleic (C18:1)	24.5	44.0	42.0	43.0	39.0
Linoleic (C18:2)	53.0	2.0	12.0	10.5	22.0
Linolenic (C18:3)	7.0		.6	.5	
Unsaturated/saturated	5.45	.97	1.24	1.37	2.37

Quality of a given fat may vary considerably between vendors as well as within one source over time. This is particularly true for blended products, whose composition will depend upon availability and price of component fats. Therefore, more stringent quality control on feed fats is required. Rouse (1987 Kansas Formula Feed Conference, KSU, Manhattan) suggested the following as minimum specifications for fats and blends (shown in Table 30.2 and list following).

Table 30.2. Minimum specification for feed fats (Rouse)

Item	Animal	Blended Animal	Blended Animal + Vegetable	Feed Grade Vegetable
Total fatty acids, Min. %	90	90	90	90
Free fatty acids, Max. %	15	15	30	50
Moisture, Max. %	1	1	1	1.5
Impurities, Max. %	.5	.5	.5	1.0
Unsaponafiable, Max. %	1	1	3.5	4.0
Total MIU, Max. %	2	2	5	6

Additional specifications:

1) Fats must be stabilized with a feed or food grade antioxidant added at levels recommended by the manufacturer.
2) Blended fats shall include only tallow, grease, poultry fat, and acidulated vegetable soapstock. Any other by-products should be included only with the knowledge and consent of the buyer.
3) It must be certified that PCB and pesticide residues in fats are within allowable limits set by state and/or federal agencies.
4) Fats shall not contain more than trace levels of any heavy metal or other contaminant.
5) Suppliers should make every effort to provide a uniform fat formulation in each delivery. This can be accomplished through the use of minimum or maximum iodine values.
6) Suppliers should furnish research data to support metabolizable or net energy claims.

Experimental Procedures

Trial 1. One hundred-forty exotic crossbred steers (primarily Simmental and Charolais x English breeds) were assigned to five weight replicates to evaluate four treatments (7 head/pen): 1) nonfat control, 2) soybean oil, 3) fancy tallow, and 4) yellow grease. Estimated ratios of unsaturated:saturated fatty acids were 5.45, .97, and 1.24 for treatments two, three, and four, respectively. Fat sources were included at 3.5% of diet dry matter and were introduced to cattle in the final ration (Table 30.3).

Starting and ending weights were the average of two consecutive early morning full weights. Ending weights were pencil shrunk 4%. Starting weights were obtained at the time steers were placed on the final ration. Steers had been weighed and allotted to treatments prior to the step-up period, which explains the slight variability in starting weights (Table 30.4).

Trial 2. Two hundred-sixteen steers were allotted to five weight replicates to evaluate five treatments in an incomplete randomized block design. Treatments were 1) a nonfat control, 2) acidulated soybean soapstock (SBSS), 3) tallow, 4) a blend of 70% SBSS: 30% tallow, and 5) yellow grease.

Steers were individually weighed and ear-tagged upon arrival. The following day, they were processed and sorted to their appropriate pen. Off truck weights, adjusted up to pay weight, were used as initial weights. Final weights were the average of two consecutive early morning full weights and pencil shrunk 4%. Fat sources were introduced in the third "step-up" ration at 1.5% on a dry matter basis. Fat sources were increased to 3.5% of diet dry matter when cattle were placed on the final ration (Table 30.5), 11 days after arrival.

In both trials, fat sources were maintained at 130-140°F in 55 gallon barrels equipped with wrap-around heaters. Hot fat was applied to the grain portion of the ration at mixing time.

Results and Discussion

Trial 1. Steers fed fat in this trial gained faster ($P<.05$) than control steers (Table 30.4). Steers fed yellow grease had the highest dry matter consumptions, which were 1 lb/head/day higher ($P<.05$) than those of steers fed tallow.

Steers fed fat had higher ($P<.05$) dressing percentages and carcass weights than control steers. With the exception of tallow, fat feeding tended to increase carcass quality (marbling). It is probable that tallow had less impact on carcass quality because that treatment had lower dry matter intakes relative to the other fat treatments.

Feed costs of gain and economic return of fat sources in this trial are presented in Table 30.7. Ration costs presented are ingredient costs plus $20/ton. Raw soybean oil, tallow, and yellow grease were priced at 22, 17, and 13 cents per lb, respectively. Relative to the nonfat control, costs of gain (feed cost/lb of gain) were reduced (7 cents/lb) only by yellow grease. However, because of increased carcass yield and quality, feeding fat produced more pounds of salable product with the same number of days on feed. Thus, there was an economic benefit to feeding fat in this trial, even for raw soybean oil at 22 cents per lb.

Trial 2. Dry matter intake (Table 30.6) by steers fed yellow gease in this study was lower ($P<.05$) than that by steers fed either no fat or acidulated soybean soapstock (SBSS) and also tended to be lower than for steers fed the blend of 70% SBSS and 30% tallow (SBSS:tallow). As a result, daily gain for steers fed yellow grease was lower ($P<.05$) than that for steers fed the other fat sources. Relative to the nonfat control, feed efficiency was improved 2.8, 7.1 ($P<.05$), 7.7 ($P<.05$), and 3.6% by SBSS, tallow, SBSS:tallow, and yellow grease, respectively.

Performance of steers fed SBSS:tallow was greater than that predicted from the weighted average of SBSS and tallow fed separately in this trial. The magnitude of the difference is depicted in Table 30.8.

The reason for this positive associative action is unclear. In monogastrics, similar ratios of vegetable oil to tallow have produced positive associative effects on carcass energy retention.

Steers fed SBSS, tallow, or SBSS:tallow had heavier carcasses ($P<.10$) than steers fed yellow grease and were numerically heavier than control steers (Table 30.6). No differences in dressing percentages were noted. Overall low carcass yields are attributed to extremely heavy mud conditions prior to slaughter. Adding fat to the diet increased backfat thickness by an average of 14.5% ($P<.05$) and marbling by 2% ($P<.10$).

Feed costs of gain and economic return in this trial are shown in Table 30.9. Ration costs reflect ingredient costs plus $20 per ton. Soybean soapstock, SBSS:tallow, and yellow grease were priced at 13 cents per lb, and tallow was priced at 17 cents in this comparison. The SBSS:tallow blend was the only fat source in this trial that reduced costs of gain compared to the control. However, when the differences in carcass value were considered, SBSS, tallow, or SBSS:tallow returned 3 to 5 dollars per head above the cost of the respective fat. The return on yellow grease was negative in this trial, in complete disagreement with results obtained in trial 1. That probably illustrates the effects of the variability encountered with some blended fats.

Based on performance of steers in these studies, NEg values were obtained for the various fat sources (Tables 30.4 and 30.6). In order to be confident of these energy values, interactive factors such as grain processing method, fat level, ionophore level, dietary levels of various minerals, and environment must be understood. Also, when blended fats are used, their composition and quality must be stringently controlled.

Table 30.3. Composition of Final Diets Fed in Trial 1

Ingredient	Control	Soybean oil	Tallow	Yellow grease
Flaked milo	80.00	80.00	80.00	80.00
Alfalfa hay	4.75	4.75	4.75	4.75
Corn silage	4.00	4.00	4.00	4.00
Supp. 8703	5.25	5.25	5.25	5.25
Molasses	6.00	2.50	2.50	2.50
Soybean oil	--	3.50	--	--
Tallow	--	--	3.50	--
Yellow grease	--	--	--	3.50

aDry matter basis. Formulated to contain 12.0% CP, .65% Ca, .29% P and .6% K. Rumensin and Tylan fed at 25 and 10 g/ton, respectively (90% dry basis).

Table 30.4. Influence of Fat Source on Performance and Carcass Quality of Finishing Steers in Trial 1 (March 4 to June 30 or July 14, 1987; average of 122 days fed)

Item	Control	Soybean oil	Tallow	Yellow grease	SE
No. pens	5	5	5	5	
No. steers	35	35	35	35	
Starting weight, lb	810	798	797	813	7
Pay weight out, lb[1]	1189	1210	1198	1234	11
Daily gain, lb	3.13^{c}	3.38^{ab}	3.31^{b}	3.48^{a}	.06
Daily feed, lb DM	19.59^{ab}	19.61^{ab}	19.08^{b}	20.08^{a}	.34
Feed/gain	6.28^{b}	5.80^{a}	5.79^{a}	5.77^{a}	.13
NEg fat, Mcal/cwt	--	142.9	155.9	167.0	--
	----------Carcass traits----------				
Hot weight, lb	755^{b}	778^{ab}	770^{ab}	9	
Dressing percent	63.42^{b}	64.57^{a}	64.15a	64.13a	.25
Backfat, in	.32	.37	.33	.34	.02
Marbling score[2]	5.07	5.12	5.00	5.15	.08
Percent choice	62	79	62	79	

[1]Final live weights shrunk 4%.
[2]Slight 50=4.5, small 50=5.5.
[abc]Means in a row with different superscripts differ (P<.05).

Table 30.5. Composition of Final Diets Fed in Trial 2

Ingredient	Control	SBSS[b]	Tallow	70 SBSS: 30 Tallow	Yellow grease
Flaked milo	83.9	83.9	83.9	83.9	83.9
Alfalfa hay	4.0	4.0	4.0	4.0	4.0
Corn silage	4.0	4.0	4.0	4.0	4.0
Supp. 8710	4.6	4.6	4.6	4.6	4.6
Molasses	3.5	--	--	--	--
SBSS	--	3.5	--	2.45	--
Tallow	--	--	3.5	1.05	--
Yellow grease	--	--	--	--	3.5

aDry matter basis. Formulated to contain 12% CP, .65% Ca, .32% P and .7% K.
[b]Rumensin and Tylan fed at 20 and 10 g/ton, respectively (90% dry basis).
[b]Acidulated soybean soapstock.

Table 30.6. Influence of Fat Source on Performance and Carcass Quality of Finishing Steers in Trial 2 (September 23 to December 21, 1987; 89 days fed)

Item	Control	SBSS4	Tallow	70 SBSS4: 30 Tallow	Yellow grease	SE
No. pens	5	5	5	5	4	
No. steers	45	45	45	45	36	
Pay weight in, lb[1]	845	845	845	844	844	1
Pay weight out, lb[2]	1147	1157	1159	1162	1138	6
Daily gain, lb	3.40^{de}	3.50^{cd}	3.52^{cd}	3.57^{c}	3.30^{e}	.07
Daily feed, lb DM	21.62^{a}	21.69^{ab}	20.86^{ab}	21.01^{ab}	20.28^{b}	.36
Feed/gain	6.38^{b}	6.20^{ab}	5.93^{a}	5.89^{a}	6.15^{ab}	.12
NEg fat, Mcal/cwt	-	97.5	171.8	179.9	123.0	
	----------Carcass traits----------					
Hot weight, lb	712^{cd}	719^{c}	719c	721^{c}	707^{d}	4
Dressing percent	62.05	62.12	62.07	62.02	62.09	.25
Backfat, in	.31^{b}	.35^{ab}	.37^{a}	.34^{ab}	.36^{ab}	.02
Marbling score[3]	5.03^{d}	5.07^{cd}	5.20^{c}	5.07^{cd}	5.18^{c}	.07
Percent	56	69	62	58		

[1]Initial weights adjusted to pay weight.

[2]Final live weights shrunk 4%.

[3]Slight 50=4.5, small 50=5.5.

[4]Acidulated soybean soapstock.

[ab]Means in a row with different superscripts differ (P<.05).

[cde]Means in a row with different superscripts differ (P<.10).

Table 30.7. Effect of Fat Source on Cost of Gain and Economic Return (Trial 1)

Item	Control	Soybean oil	Tallow	Yellow grease
Ration cost, $/ton[a]	84.20	94.50	91.76	89.36
Ration cost, $/head	134.16	150.72	142.40	145.94
Cost above control, $/head	---	16.56	8.24	11.78
Feed cost of gain, $/lb	.354	.366	.355	.347
Economic return, carcass basis[b]				
Carcass value, $/head	777.58	808.65	793.02	823.44
Value above control, $/head	---	31.07	15.44	45.86
Return above feed cost, $/head	---	14.51	7.20	34.08
Economic return, live basis[c]				
Final weight, lb[d]	1185	1217	1205	1225
Value, $/head	788.03	809.31	801.33	814.63
Value above control, $/head	---	21.28	13.30	26.60
Return above feed cost, $/head	---	4.72	5.06	14.82

[a]Ingredient costs plus $20/ton. Soybean oil, tallow, yellow grease priced at 22, 17 and 13 cents per lb, respectively. Blended molasses priced at $70 per ton.
[b]Carcass prices: $105 choice, $100 good.
[c]Cash price: $66.50
[d]Adjusted for initial weight and shrunk 4%.

Table 30.8. Effect of a 70:30 Blend of Acidulated Soybean Oil Soap Stock and Tallow on Steer Performance

	Daily gain	Dry matter consumption (lb/day)	Feed/ gain
Predicted	3.51	21.44	6.12
Observed	3.57	21.01	5.89
Difference	1.7%	-2.1%	3.9%

Table 30.9. Effect of Fat Source on Cost of Gain and Economic Return (Trial 2)

Item	Control	SBSS[a]	Tallow	70 SBSSa: 30 Tallow	Yellow grease
Ration cost, $/ton[b]	83.50	88.98	91.16	88.98	88.98
Ration cost, $/head	107.11	114.51	112.83	110.92	107.07
Cost above control, $/head	-	7.40	5.72	3.81	.16
Feed cost of gain, $/lb	.355	.367	.359	.349	.364
Economic return, carcass basis[c]					
Carcass value, $/head	731.94	743.81	741.29	741.91	729.62
Value above control, $/head	--	11.87	9.37	9.97	-2.32
Return above cost, $/head	-	4.47	3.63	6.16	-2.48
Economic return, live basis[d]					
Value, $/head	757.02	763.62	764.94	766.92	751.08
Value above control, $/head	-	6.60	7.92	9.90	-5.94
Return above feed cost, $/head	-	-.80	2.20	6.09	-6.10

aAcidulated soybean soapstock.

[b]Ingredient costs plus $20/ton. Soapstock, tallow, blend and yellow grease priced at 13, 17, 13 and 13 cents per lb., repectively. Blended molasses priced at $70 per ton.

[c]Carcass price: $105 choice, $100 good.

[d]Cash price: $66.50.