INTERACTIVE EFFECTS OF MODIFIED TALL OIL AND FAT SOURCE ON GROWTH PERFORMANCE AND CARCASS CHARACTERISTICS OF FINISHING BARROWS AND GILTS

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Summary

A total of 144 pigs (initially 90 lb) was used to determine the interactive effects of fat source: none (NF), 6% choice white grease (CWG), or 6% poultry fat (PF); modified tall oil (MTO, 0 or .5%); and sex (barrows or gilts) on growth performance and carcass characteristics. Regardless of fat source, MTO improved belly firmness but did not influence growth performance. Gilts were leaner, had increased loin muscle area, and had softer bellies compared to barrows. Added fat decreased ADFI and improved F/G. Pigs fed PF had the best F/G, but the fattest carcasses and softest loins and bellies.

(Key Words: Finishing Pigs, Fat, Modified Tall Oil.)

Introduction

Adding animal fat to increase the energy concentration of diets is a common practice in the swine industry. Previous research conducted at Kansas State University showed that when pigs were fed diets containing 2 to 6% CWG or PF, F/G improved without affecting loin muscle area, tenth rib backfat, or lean percentage, with no differences observed between fat sources. However, the study showed that adding CWG had no adverse affects on carcass quality, but PF tended to increase loin cooking loss and was associated with a greater incidence of "off flavors" in bacon sensory evaluations. Research in other laboratories has shown that pigs fed diets containing unsaturated animal fats, such as PF, may have less desirable carcass characteristics (softer and more unsaturated fat) compared to pigs fed diets containing CWG.

Recent research conducted at Kansas State University has shown that feeding diets containing .5% MTO improved growth performance as well as decreased backfat and improved lean percent, longissimus drip loss, and belly firmness. Consequently, we hypothesized that perhaps the detrimental effects on pork quality exhibited by pigs fed unsaturated animal fats could be alleviated by the addition of MTO. Therefore, the objective of this research was to determine the interactive effects of sex, MTO, and fat source on growth performance and carcass characteristics of finishing pigs.

Procedures

A total of 144 pigs (initially 90 lb) was allotted by sex, ancestry, and weight to one of 12 treatments. Experimental treatments had six replications (pens) and two pigs per pen.

The 12 treatments were arranged in a 2×2×3 factorial with main effects of sex (barrows or gilts); MTO (0 or .5%); or fat source (none, 6% CWG, or 6% PF). Dietary treatments (Table 1) were fed in meal form in two phases (90 to 146 and 146 to 250 lb). Modified tall oil replaced corn starch in the basal diet on an equal weight basis. Diets were formulated on an equal lysine:calorie ratio basis.

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Pigs were housed in an environmentally controlled building in 5×5 ft pens. Each pen contained one nipple waterer and one self-feeder to provide ad libitum access to feed and water. Pigs were weighed every 14 d to determine ADG, ADFI, and F/G.

One pig per pen was slaughtered when the average weight of pigs within a block reached 250 lb. Organs (heart, kidneys, liver, and leaf fat) were weighed on the day of slaughter. Standard carcass measurements; visual analyses of the longissimus for color, marbling, and firmness; drip loss; belly firmness; and Minolta colorspectrometry (Hunter L*, a*, and b*) of the longissimus muscle and surrounding fat were determined for each pig at 24 hr postmortem.

Data were analyzed as a 2×2×3 factorial arrangement with pen as the experimental unit using the GLM procedure of SAS. The model contained main effects of sex, MTO, and fat source as well as all possible two- and three-way interactions. Hot carcass weight was used as a covariate for all carcass analysis. Belly length and weight also were used as covariates for the belly firmness analysis.

Results and Discussion

The only main effect interaction (Table 2) occurred for F/G from 90 to 146 lbs (sex × fat source interaction, $P<.05$). Feed to gain ratio was better for barrows and gilts fed diets containing added fat than for those fed diets containing no fat. However, the interaction was the result of barrows fed either CWG or PF exhibiting similar F/G, whereas gilts fed PF had better F/G than those fed CWG.

The remaining treatment differences will be reported as main effect differences only. Average daily gain and ADFI were greater ($P<.0001$) for barrows than for gilts. The addition of MTO did not affect ($P>.10$) ADG, ADFI, or F/G. Pigs fed diets with no added fat tended to have lower ($P<.06$) ADG compared to pigs fed diets containing CWG, and pigs fed diets containing PF had intermediate ADGs. Average daily feed intake was greatest ($P<.002$) for pigs fed diets without added fat and lowest for pigs fed diets containing PF ($P<.0001$).

Main effect differences of carcass characteristics are shown in Table 3. Barrows had thicker tenth rib and average backfat measurements; smaller longissimus muscle areas; lower lean percents and longissimus muscle pHs; and firmer bellies initially and after 1 minute compared to gilts ($P<.04$). Barrows also tended to have redder (visual color) loins; shorter carcasses; and firmer bellies after 5 minutes compared to gilts ($P<.10$). Modified tall oil only tended to improve ($P<.08$) belly firmness initially and after 1 and 5 minutes. Pigs fed diets without fat had greater ($P<.007$) longissimus drip loss and lower ($P<.03$) pH and tended to have softer ($P<.07$) longissimus muscles compared to pigs fed diets containing CWG. Pigs fed diets containing CWG had firmer ($P<.008$) longissimus muscles, less ($P<.04$) longissimus drip loss, and greater ($P<.03$) pH and tended to have less ($P<.09$) average backfat, redder (visual color; $P<.06$) longissimus muscles, and firmer ($P<.09$) bellies after 1 minute compared to pigs fed diets containing PF. Pigs fed diets containing PF had greater ($P<.002$) average backfat thickness, shorter ($P<.05$) carcasses, and softer ($P<.005$) bellies initially and after 1 and 5 minutes compared to pigs fed diets without fat.

Objective color characteristics of the longissimus muscle and fat were not influenced ($P>.10$; Table 4) by MTO or fat source. Barrows had redder (a*), more yellow (b*), and more orange (hue angle) and more intensely colored (saturation index) ($P<.02$) longissimus muscles compared to gilts. The fat surrounding the longissimus muscle was lighter (L*), less red (a*), more yellow (b*), and orange (hue angle) and was more intensely colored (saturation index) ($P<.03$) for barrows compared to gilts.

These results are similar to those previous trials conducted at Kansas State University. Pigs fed diets containing added fat were more efficient than pigs fed diets without fat, and pigs fed diets containing PF had the best

F/G. This is because PF has a slightly greater energy value than CWG (3,710 vs. 3,608 kcal/lb M.E.). However, pigs fed diets containing added fat tended to have poorer carcass characteristics (greater backfat thickness and softer bellies) compared to pigs fed diets without fat. Pigs fed the PF diets had the poorest carcass characteristics compared to pigs fed no fat or CWG diets. Modified tall oil did not influence growth and carcass composition to the same degree as it has in past research and only tended to improve belly firmness. Although no interactions were observed, MTO numerically improved belly firmness of pigs fed diets containing CWG or PF to levels similar to those of pigs fed diets containing NF. Further research to determine the interactive effects of sex, MTO, and fat source on the sensory, texture, and firmness characteristics of bellies and longissimus muscles is still ongoing.

In conclusion, regardless of fat source, MTO improved belly firmness, but did not influence growth performance. Gilts were leaner, had increased loin muscle areas, and had softer bellies compared to barrows. Added fat decreased ADFI and improved F/G. Pigs fed PF had the best F/G, but the fattest carcasses and softest loins and bellies.

Table 1. Compositions of Basal Diets (As-Fed Basis)[a]

Ingredient, %	90 to 146 lb	146 to 250 lb
Corn	69.28	82.81
Soybean meal, 46.5%	26.86	14.11
Monocalcium phosphate	1.35	.85
Limestone	1.08	.87
Corn starch[b]	.50	.50
Salt	.35	.35
Lysine-HCl	.15	.15
Vitamin premix	.15	.13
Trace mineral premix	.15	.10
Medication	.125	.125
Ethoxyguinn	.005	.005
Total	100.00	100.00
Calculated Analysis		
Lysine, %	1.10	.75
Methionine, %	.29	.22
Ca, %	.75	.55
P, %	.65	.50
g lys/Mcal ME	3.35	2.26

[a]Diets were formulated to the same g lys/Mcal ME ratio when choice white grease or poultry fat was added by adjusting the corn and soybean meal ratio.

[b]Modified tall oil replaced corn starch in the basal diet on an equal weight basis.

Table 2. Interactive Effects of Modified Tall Oil and Fat Source on Growing Performance of Barrows and Gilts[a]

	Barrows						Gilts						
	0 MTO			.5% MTO			0 MTO			.5% MTO			
Item	NF[b]	CWG	PF	NF	CWG	PF	NF	CWG	PF	NF	CWG	PF	SEM
90 to 250 lb													
ADG[cd]	2.38	2.48	2.29	2.36	2.42	2.39	2.02	2.18	2.20	2.06	2.06	2.09	.064
ADFI[ce]	6.58	6.53	5.63	6.50	6.03	5.80	5.80	5.48	4.94	5.85	5.36	4.94	.151
F/G[f]	2.77	2.63	2.47	2.77	2.49	2.43	2.87	2.52	2.25	2.85	2.61	2.37	.069

[a]Values represent the means of two pigs (initially 90 lb) per pen with six replications per treatment.

[b]Fat source: NF - no added fat; CWG = 6% added choice white grease; and PF = 6% added poultry fat.

[c]Sex effect. $P<.0001$.

[d]NF vs. CWG. $P<.06$.

[e]NF vs. CWG vs. PF. $P<.002$.

[f]Sex × fat source interaction, $P<.05$.

Table 3. Effects of Sex, Modified Tall Oil, and Fat Source on Carcass Characteristics[a]

	Sex		MTO		Fat Source[b]				Probability, $P<$		Fat Source; Contrasts, $P<$[c]		
Item	Barrows	Gilts	0	.5%	NF	CWG	PF	SEM	Sex	MTO	1	2	3
Shrink loss, %	.79	1.00	.89	.90	.93	.77	.99	.105	.10	.94	.28	.14	.70
Backfat, in													
Tenth rib	.91	.77	.86	.81	.81	.82	.89	.049	.02	.39	.88	.28	.23
Average[d]	1.13	1.06	1.10	1.09	1.05	1.09	1.14	.020	.002	.68	.11	.09	.002
LMA, in^2	6.30	6.91	6.49	6.72	6.65	6.74	6.42	.161	.002	.22	.71	.17	.32
Lean %	51.72	54.39	52.55	53.55	53.51	53.53	52.12	.778	.004	.27	.98	.20	.22
Dressing %	75.43	74.92	75.29	75.06	74.91	75.20	75.43	.340	.19	.57	.54	.64	.29
Visual color[e]	2.61	2.34	2.46	2.50	2.39	2.71	2.34	.137	.09	.80	.10	.06	.80
Firmness[e]	2.59	2.43	2.52	2.49	2.45	2.75	2.32	.113	.21	.79	.07	.008	.39
Marbling[e]	2.27	2.12	2.09	2.30	2.16	2.29	2.14	.132	.34	.16	.46	.40	.92
Drip loss, %	6.05	5.86	5.77	6.13	6.78	4.78	6.30	.505	.74	.54	.007	.04	.51
Carcass loss, %	32.59	32.89	32.74	32.73	32.95	32.73	32.54	.136	.06	.98	.26	.33	.05
Muscling	2.50	2.49	2.47	2.52	2.51	2.48	2.49	.049	.89	.43	.67	.84	.83
pH	5.62	5.70	5.66	5.66	5.65	5.68	5.65	.013	.0001	.91	.03	.03	.98
Belly Firmness[f]													
Initial	14.86	12.21	12.61	14.16	15.44	13.62	11.54	.916	.04	.08	.15	.11	.005
1 min	13.58	11.04	11.39	13.24	14.13	12.42	10.39	.860	.03	.06	.15	.09	.004
5 min	12.51	10.42	10.57	12.36	13.28	11.52	9.60	.814	.06	.06	.12	.10	.003

[a]Values represent the means of one pig per pen and 36 or 24 pens per treatment. Hot carcass weight was used a covariate for the statistical analysis.
[b]Fat source: NF = no added fat; CWG = 6% added choice white grease; and PF = 6% added poultry fat.
[c]Contrasts were: 1) NF vs. CWG, 2) CWG vs. PF, and 3) NF vs. PF.
[d]Refers to the average of the first rib, last rib, and last lumbar fat depths.
[e]Scoring systems of 1 to 5: 2 - grayish pink, soft and watery, or traces to slight; 3 = reddish pink, slightly firm and moist, or small to modest.
[f]Refers to the degree of droop (inches) when the bellies were centrally suspended on a bar, skin side up. Larger values indicate firmer bellies. Belly weight and length were used as covariates in this portion of the statistical analysis.

Table 4. Effects of Sex, Modified Tall Oil, and Fat Source on Objective Color Characteristics of Longissimus Muscle and Fat[a]

	Sex		MTO		Fat Source[b]				Probability, $P<$		Fat Source; Contrasts, $P<$[c]		
Item	Barrows	Gilts	0	.5%	NF	CWG	PF	SEM	Sex	MTO	1	2	3
Muscle[d]													
Hunter L*[f]	59.54	57.61	58.91	58.24	59.12	58.33	58.27	1.08	.12	.59	.60	.97	.58
Hunter a*[f]	10.38	8.93	9.64	9.67	9.71	9.35	9.91	.334	.0003	.94	.45	.24	.68
Hunter b*[f]	17.94	14.29	16.18	16.05	16.27	15.69	16.39	.497	.0001	.83	.41	.32	.86
Hue angle[f]	59.96	58.03	59.23	58.76	59.14	59.10	58.74	.729	.02	.58	.97	.73	.71
Saturation index[f]	1.35	1.32	1.34	1.34	1.34	1.33	1.34	.004	.0001	.83	.50	.30	.72
A:B ratio[f]	.58	.63	.60	.61	.60	.60	.61	.017	.02	.63	.96	.69	.67
Fat[e]													
Hunter L*[f]	85.08	81.67	83.71	83.04	83.66	83.72	82.74	.681	.0001	.40	.95	.31	.35
Hunter a*[f]	.81	1.63	1.15	1.28	1.23	1.22	1.31	.167	.0001	.50	.66	.44	.74
Hunter b*[f]	11.41	9.92	10.61	10.71	10.73	10.55	10.70	.202	.0001	.66	.53	.59	.93
Hue angle[f]	55.60	81.10	67.46	69.24	70.62	61.15	73.28	9.65	.03	.87	.49	.37	.85
Saturation index[f]	1.28	1.26	1.27	1.27	1.27	1.27	1.27	.003	.0001	.46	.98	.92	.95
A:B ratio[f]	.07	.16	.11	.12	.12	.11	.13	.016	.0001	.60	.83	.55	.71

[a]Values represent the means of one pig per pen and 36 or 24 pens per treatment. Hot carcass weight was used a covariate for the statistical analysis.
[b]Fat source: NF = no added fat; CWG = 6% added choice white grease; and PF = 6% added poultry fat.
[c]Contrasts were: 1) NF vs. CWG, 2) CWG vs. PF, and 3) NF vs. PF.
[d]Values are the means of two readings of the longissimus muscle taken at the tenth rib.
[e]Values are the means of four readings of the fat surrounding the longissimus muscle.
[f]Measures of dark to light (Hunter L*), redness (Hunter a*), yellowness (Hunter b*), red to orange (hue angle), or vividness or intensity (saturation index).