Nutritive Value of Sunflower Seed for Swine

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Summary

Sunflower seed (SFS) was evaluated as a feedstuff for growing and finishing swine. In all trials, SFS was added on an isolysine basis: 10 parts SFS replacing 8 parts corn and 2 parts soybean meal. Replacement levels were 20, 40, and 60% in the growth and the digestion trials, 25 and 50% in the finishing trial.

Feed intake of growing pigs decreased linearly as the level of SFS in their diets increased. At 20 and 60% levels, effect on daily gain was not significant, but at 40% replacement weight gain decreased. Ether extract digestibility increased and energy digestibility decreased as the level of SFS was increased. Apparent digestibility of SFS was determined to be: dry mattter, 69±4%; energy, 77±5%; ether extract, 91±3%; and protein, 79±5%.

Average daily gain was significantly higher for finishing pigs fed the control diet than for those fed either 25 or 50% SFS, but for all diets feed required per unit of gain was similar. Increasing the level of SFS in the diet increased the total unsaturation of the lipid of backfat and longissimus dorsi. The most dramatic change was the increase of linoleic acid (from 14.7% to 34.0% to 40.5% for backfat and 9.0% to 25.3% to 32.1% for longissimus dorsi samples, respectively, for pigs fed the control, 25%, and 50% SFS diets). Backfat thickness did not differ significantly among treatments, but the trend was toward increasing amounts of intramuscular fat as SFS in the diet was increased.

Introduction

Increased cost of commonly used energy and protein sources for swine diets has increased interest in other potential feedstuffs. These experiments were conducted to determine the nutritive value of sunflower seed (SFS) for growing and finishing swine, and its effects on carcass fatty acid composition.

Procedure

General. In the growth trial (trial 1), pigs were housed in an environmentaly controlled nursery. Feed and water were supplied ad libitum. Initial and final pigs weights were recorded; daily weight gain, feed efficiency, and daily feed intake were determined at the end of the 21 day trial.

In the digestion trial (trial 2), pigs were housed individually in metabolism cages allowing for separate collection of feces and urine. Daily feed intake was constant for each replication and was fed in two equal portions. Fresh water was supplied at each feeding. A pre-test period lasting 5 days preceded each 5 day collection period.

In the finishing trial (trial 3), pigs were housed in a modified open front building enclosed with polyethelene with supplemental heat provided by catalytic heaters. Feed and water were supplied ad libitum. Initial, final, and biweekly weights were recorded; daily weight gain, feed efficiency

and daily feed intake were determined biweekly and when pigs reached slaughter weight (at approximately 220 pounds). Seven pigs per treatment were slaughtered. Backfat and longissimus dorsi samples were analyzed for fatty acid composition and total lipids.

All diets, formulated to meet NRC (1968) requirements for the growing or finishing pig, were fed in pellet form.

Sunflower seed (table 8.1) were added on an isolysine basis: 10 parts SFS replacing 8 parts corn and 2 parts soybean meal.

Trial 1. Sixty Yorkshire barrows and gilts averaging 48 pounds were allotted according to weight, sex, and sire to four dietary treatments (table 8.2): (A) control, (B) 20% SFS, (C) 40% SFS and (D) 60% SFS. The control diet, 16.5% protein corn-soybean meal, contained 0.81% lysine. The trial was replicated three times with 5 pigs per pen, lasted 21 days.

Trial 2. Twelve Yorkshire and Duroc barrows weighing an average of 37 pounds were allotted from three groups of four littermates to four dietary treatments as in trial 1.

Trial 3. Thirty Yorkshire barrows and gilts averaging 136 pounds were allotted according to weight, sex, and sire to three treatments (table 8.3): (A) control, (B) 25% SFS, (C) 50% SFS. The control diet, 14% protein corn-soybean meal, contained a lysine content of 0.63%. Sunflower seed was added as in trial 1. The trial, consisting of two replications of 5 pigs per pen, lasted until the pigs weighed approximately 220 pounds, at which time 7 pigs per treatment were slaughtered. Samples of adipose tissue from the outer layer of backfat over the shoulder were analyzed for fatty acids. Longissimus dorsi samples, taken after carcasses had chilled, were frozen and later analyzed for total lipids and fatty acid composition.

Table 8.1. Proximate, Amino Acid Analysis and Fatty Acid Composition of Sunflower Seed[a]

Proximate analysis	%	Amino acid analysis	%
Dry matter	92.44	Alanine	0.84
Ether extract	33.96	Valine	0.92
Crude fiber	14.97	Glycine	1.11
Ash	4.45	Isoleucine	0.70
Protein	19.39	Leucine	1.27
Calcium	0.15	Proline	0.83
Phosphorus	0.50	Threonine	0.63
		Serine	0.70
Fatty acid composition	**%**	Methionine	0.30
		OH-Proline	0.07
Myristic [C 14]	0.08	Phenylalanine	0.86
Palmitic [C 16]	6.96	Aspartic Acid	1.72
Palmitoleic [C 16:1]	0.23	Glutamic Acid	3.76
Stearic [C 18]	5.14	Tyrosine	0.47
Oleic [C 18:1]	13.71	Lysine	0.77
Linoleic [C 18:2]	72.93	Histidine	0.49
Higher	0.91	Arginine	1.34
Saturated	12.18	Tryptophan	0.32
Unsaturated	86.87	Cystine	0.17

[a]All values expressed on an "as is" basis. Dry matter of sample: 92.44.

Table 8.2. Composition of Diets for Growing Pigs (Trials 1 and 2)

Ingredients	Diets			
	Control	20% SFS	40% SFS	60% SFS
Corn	73.8	58.0	42.1	26.2
Sunflower seed	0.0	20.0	40.0	60.0
Soybean meal	22.2	18.2	14.2	10.2
Dicalcium phosphate	1.5	1.3	1.0	0.9
Limestone	1.0	1.0	1.2	1.2
Salt	0.5	0.5	0.5	0.5
Vitamin, trace mineral and antibiotic premix	1.0	1.0	1.0	1.0
	100.0	100.0	100.0	100.0
Analysis (determined)				
Dry matter, %	85.7	90.5	89.1	90.3
Protein, %	16.7	17.9	18.1	19.5
Ether extract, %	1.6	7.0	12.1	14.9
Gross energy, cal/gm	3832	4447	4715	5047
Analysis calculated				
Lysine, (calculated), %	0.81	0.81	0.82	0.81
Fiber, (calculated), %	2.8	5.3	8.0	10.1
Calcium, (calculated), %	0.80	0.81	0.82	0.80
Phosphorus (calculated),%	0.60	0.60	0.59	0.60

Table 8.3. Composition of Diets (Trial 3)

Ingredient	Control	25% SFS	50% SFS
Corn	81.7	61.9	41.9
Sunflower seed	0.0	25.0	50.0
Soybean meal	15.0	10.0	5.0
Dicalcium phosphate	1.0	0.8	0.6
Limestone	0.8	0.8	1.0
Salt	0.5	0.5	0.5
Vitamin, trace mineral and antibiotic premix	1.0	1.0	1.0
	100.0	100.0	100.0
Analysis (calculated)			
Protein, %	14.0	14.8	15.7
Lysine, %	0.63	0.63	0.63
Ether extract, %	3.3	11.0	18.7
Fiber, %	2.5	5.6	8.6
Calcium, %	0.59	0.58	0.61
Phosphorus, %	0.49	0.50	0.50

Results and Discussion

Trial 1. Feed intake of growing pigs decreased linearly ($P<.05$) as the percentage of SFS in the diet increased (table 8.4). Replacing corn and soybean meal with SFS increased the caloric density of the diet and, therefore, decreased feed consumption. It is well established that feed intake decreases as calorie content of the diet increases. Energy intake was similar for all treatment groups. Feed required per unit of gain decreased significantly ($P<.05$) as the level of SFS in the diet increased,

an improvement in feed efficiency was probably a function of the fat content of the SFS. Numerous experiments have demonstrated improved feed efficiency when fat is added to the diet.

Table 8.4. Performance of Growing Pigs[a]

Diets	Daily gain (lb.)	Feed gain[b]	Feed intake (lb.)	Calorie/protein[c]
Control	1.61[d]	2.33[d]	3.74[d]	23
20% sunflower seed	1.54[d,e]	2.21[e,f]	3.41[f]	25
40% sunflower seed	1.43[e]	2.12[f]	3.04[f]	26
60% sunflower seed	1.50[d,e]	2.06[f]	3.08[f]	26

[a]15 pigs, averaging 48 pounds initially, per treatment.

[b]Feed/gain and feed intake are pen means (five pigs per pen, three pens per treatment).

[c]Calculated as gross kcal per gram of protein in the diet.

[def]Means with different superscripts within a column are statistically different (P<.05).

Trial 2. Although it increased the caloric density, protien, and fiber content, replacing corn and soybean meal in the diet of growing pigs with 20, 40, or 60% SFS had little effect on apparent digestibility of protein or nitrogen retained (table 8.5). Percent nitrogen decreased linearly as the level of SFS increased in the diet, but protein digestibility was not influenced.

Table 8.5. Influence of Level of Sunflower Seeds in the Diet on Nitrogen Retention, Ether Extract, and Energy Digestibility (Trial 2)

Diets	Control	20% SFS	40% SFS	60% SFS
Daily nitrogen, g				
Intake	37.55	37.90	39.07	41.55
Urine	8.14	9.04	10.72	11.91
Feces	5.89	6.61	6.83	7.18
Retained	23.52[c]	22.25[d]	21.52[e]	22.46[e]
% retained	62.60[c]	58.60[d]	55.00[e]	54.20[e]
% digested	84.30	82.60	82.50	82.70
Daily ether extract, g				
Intake	22.80	96.13	163.68	197.76
Feces	7.59	12.85	17.19	20.25
Digested	15.21[c]	83.28[d]	146.49[d]	177.51[d]
% digested	66.50[c]	86.70[d]	89.60[d]	89.70[d]
Daily energy, kcal				
Intake	5366	6106	6354	6711
Feces	625	846	1073	1199
Digested	4741	5260[d]	5281[e]	5512[e]
% digested	88.30[c]	86.20[d]	83.10[e]	82.20[e]

[a]All values expressed on a 100% dry matter basis.

[b]Six pigs, averaging 37 lb. initially, per diet.

[cde]Percentages with different superscripts are statistically different (P<.05).

As would be expected (because of the greater relative proportion of metabolic fat in the feces of pigs on the control diet) apparent digestibility of ether extract increased significantly (P<.05) when SFS was increased to 20%; and increased only slightly with further SFS increases. Apparent digestibility of energy significantly (P<.05) decreased when SFS was increased to 40%; but there was no significant difference in digestibility between the 40 and 60% level. Adding SFS to the diets increased fiber content, which decreased energy digestibility.

The apparent digestibility of sunflower seed is presented in table 8.6.

Table 8.6. Apparent Digestibility of Sunflower Seed[ab]

Digestibility of:	Average	Percent SFS in the diet 20	40	60
Dry matter, %	68.8±4.3	66.9±6.0	69.3±3.5	70.3±2.4
Energy, %	76.9±4.4	77.5±6.9	75.2±2.9	78.1±2.0
Protein, %	79.0±5.0	75.5±6.6	80.0±4.6	81.5±1.5
Ether extract, %	91.4±2.9	91.5±4.5	91.7±2.4	91.2±1.9

[a]Digestibility determined by the indirect method and expressed on a 100% dry matter basis.

[b]Values represent mean ± SEM of six pigs per diet averaging 37 pounds.

Trial 3. Replacing corn and soybean meal with 25 or 50% SFS in the diet of the finishing pigs significantly (P<.05) reduced average daily gain (table 8.7). Reduced gain was probably a function of feed intake, which decreased as SFS increased. Adding SFS resulted in significant differences in feed efficiency. Apparently, fat content and fiber in SFS each offset the effects of each other.

Average slaughter weight and backfat thickness, respectively, on seven pigs per treatment were: control, 227 lb. and 1.38 in.; 25% SFS, 222 lb. and 1.38 in.; 50% SFS, 220 lbs. and 1.30 in.

With each increase of SFS in the diet unsaturation of backfat and longissimus dorsi lipid significantly (P<.05) increased (table 8.8), demonstrating that dietary fatty acid composition can significantly alter fatty acid composition of intramuscular fat, as well as backfat. As SFS was increased in the diet, fatty acids from C 14 to C 18:1 tended to decrease, while C 18:2 increased in both backfat and longissimus dorsi samples. Sunflower seed lipid was analyzed to be 72% linoleic, which significantly increased with each increase of SFS in the diet, indicating that diet affects fatty acid composition of intramuscular fat, muscle, and backfat. The data indicated that pigs fed SFS are capable of producing pork and lard high in unsaturated fats.

Total lipid content of longissimus dorsi were: control, 2.18%; 25% SFS, 2.37%; and 50% SFS, 2.93%. Though these values did not differ significantly, there was a trend toward greater intramuscular lipid content as SFS in the diet was increased. The increase in intramuscular lipid may not have been as great as would normally be expected because fiber and protein were increased as SFS was increased.

Table 8.7. Performance of Finishing Pigs[a]

Diets	Daily Gain (lb.)	Feed Gain[b]	Feed Intake (lb.)
Control	1.76^{c}	3.27^{c}	5.83^{c}
25% sunflower seed	1.45^{d}	3.39^{c}	4.88^{c}
50% sunflower seed	1.52^{d}	3.39^{c}	5.13^{c}

[a]10 pigs, averaging 136 lb. initially, per diet.

[b]F/G and feed intake are pen means, five pigs per pen, two pens per treatment.

[cd]Means with different superscripts are statistically different (P<.05).

Table 8.8. Fatty Acid Composition of Backfat and Longissimus Dorsi as Affected by Level of Sunflower Seed in the Diet[a]

Diet	Total Sat.	Total Unsat.	Fatty Acid, Percent C 14	C 16	C 16:1	C 18	C 18:1	C 18:2	Higher
Backfat									
Control	40.4^{b}	57.9^{b}	1.10^{b}	23.86^{b}	3.13^{b}	15.43^{b}	40.10^{b}	14.69^{b}	1.65^{b}
25% sunflower seed	31.9^{c}	66.2^{c}	0.88^{c}	18.79^{c}	1.91^{c}	12.24^{c}	30.25^{c}	34.00^{c}	1.88^{c}
50% sunflower seed	26.8^{d}	70.7^{d}	0.71^{d}	15.76^{d}	1.90^{c}	10.36^{d}	28.24^{c}	40.52^{d}	1.87^{c}
Longissimus Dorsi									
Control	40.8^{b}	59.1^{b}	1.42^{b}	26.95^{b}	3.32^{b}	12.46^{b}	46.76^{b}	9.06^{b}	
25% sunflower seed	35.8^{c}	64.2^{c}	1.47^{b}	23.05^{c}	2.73^{c}	11.29^{b}	36.15^{c}	25.27^{c}	Not determined
50% sunflower seed	28.8^{d}	71.1^{d}	1.03^{c}	18.60^{d}	2.00^{d}	9.19^{c}	31.03^{d}	38.11^{d}	

[a]Percentages are means of 7 samples per treatment.

[bcd]Means with different superscripts are statistically (P<.05) different.