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EFFECT OF DIET PARTICLE SIZE ON UTILIZATION OF SUNFLOWER OIL SEEDS IN NURSERY PIG DIETS

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Summary

One hundred ninety-two weanling pigs were fed diets containing 15 or 25% sunflower oil seeds that were ground using a hammermill equipped with either a 1/8 or 3/16 in. screen. Average daily gain (ADG) of pigs fed the 25% sunflower seed diet ground through a 1/8 in. screen was similar to ADG of pigs fed the control diet or that with 15% sunflower seeds, although there was a reduction in ADFI. This indicates that finely ground sunflower seeds can be utilized in nursery pig diets up to 25% with no impairment in performance.

(Key words: Nursery Pigs, Sunflower Seeds, Particle Size.)

Introduction

The total number of acres devoted to production of sunflower seeds in Kansas increased dramatically from approximately 64,000 acres in 1982 to over 195,000 acres in 1988. Because of this increased production, sunflower seeds may at times become available for use in swine diets. Sunflower oil seeds contain about 40% oil (Table 1), which suggests a potential use when fat is added to increase the energy density of swine diets. High energy-density diets for nursery pigs usually contain fat. Research at Kansas State University has indicated that sunflower oil seeds can be included at 15% of nursery pig diets with no reduction in performance. Because of their relatively high fiber content, diets containing higher percentages of sunflower seeds fed to nursery pigs resulted in reduced growth performance. Research conducted with high fiber feeds, such as barley, indicated that fine grinding allows improved utilization of those feeds. Therefore, this study was designed to evaluate diets containing sunflower oil seeds ground using a hammermill equipped with either a 1/8 or 3/16 in screen.

Table 1. Chemical Analysis of Black Sunflower Oil Seeds

Component	Percentage
Moisture	6.36
Fat	47.64
Protein	19.46
Crude fiber	19.70
Ash	3.37
Nitrogen free extract	3.47
Lysine	.84

Experimental Procedures

Three dietary treatments were formulated: control and 15 or 25% sunflower oil seeds (Table 2). The control diet was ground through a hammermill equipped with a 3/16 in screen. The diets containing 15 and 25% sunflower seeds were ground using a hammermill equipped with either a 1/8 in or a 3/16 in hammermill screen (Table 3). One hundred ninety-two weanling pigs averaging 13.0 lb were allotted randomly (eight pigs/pen, five pens/treatment for those diets containing 15 and 25% sunflower seeds and four pens for the diet with no sunflower seeds) according to weight, sex, and ancestry. Pigs were housed in an environmentally controlled nursery and individually weighed each week during the 5-week trial. Feed additions were recorded, and performance measures of average daily gain (ADG), average daily feed intake (ADFI), and feed conversion (F/G) were calculated weekly. The diets were analyzed for particle size diameter, standard deviation of particle size, surface area, and number of particles per gram (Table 3).

Results and Discussion

Particle size parameters of experimental diets are shown in Table 3. Grinding both the 15 and 25% sunflower seed diets through a hammermill equipped with a 1/8 in. screen reduced particle diameter by approximately 9% and increased surface area approximately 10% compared to diets ground through a 3/16 in screen.

The performance data (Table 4) showed no significant differences in ADG or F/G of pigs for the first two weeks. ADFI was significantly reduced ($P<.05$) for pigs fed both diets containing 25% sunflower seeds.

The five week data indicated no difference in ADG between pigs fed the control diet and the 15% sunflower seed diets ground through either a 1/8 or 3/16 in screen. Pigs fed the 25% sunflower seed diet (3/16 in grind) grew significantly slower ($P<.05$) than pigs fed the control or the 15% sunflower seed diets. However, pigs fed the 25% sunflower seed diet (1/8 in. screen) demonstrated a similar ADG to those pigs fed the control and 15% sunflower seed diets. ADFI was significantly reduced ($P<.05$) for pigs fed the 25% sunflower seed diets, but F/G was similar for all treatments. These data suggest that finely grinding diets (1/8 in. screen) containing sunflower seeds increases the potential for sunflower inclusion in nursery pig diets from 15 to 25%, without significant impairment in pig performance.

Table 2. Composition of Diets

Ingredients	Percentage sunflower oil seeds		
	0	15	25
Corn	44.62	37.07	29.13
Soybean meal (48% CP)	27.28	23.89	21.85
Sunflower oil seeds	--	15.00	25.00
Dried whey	20.00	20.00	20.00
Soybean oil	4.00	--	--
Monocalcium phosphate	1.68	1.69	1.73
Limestone	.68	.65	.59
Salt	.10	.10	.10
Trace mineral premix ^a	.10	.10	.10
Vitamin premix ^b	.25	.25	.25
Copper sulfate	.10	.10	.10
Selenium premix ^c	.05	.05	.05
L-lysine HCl	.10	.10	.10
Antibiotic ^d	1.00	1.00	1.00
<u>Calculated analysis</u>			
Crude fiber, %	2.0	4.6	6.4
ME, Kcal/lb	1,564	1,527	1,553
Lysine, %	1.25	1.25	1.25
Calcium, %	.9	.9	.9
Phosphorus, %	.8	.8	.8

^aContaining 10% Mn, 10% Fe, 10% Zn, 4% Ca, 1% Cu, .4% K, .3% I, .2% Na, and .1% Co.

^bEach lb of premix contains: vitamin A, 1,000,000 IU; vitamin D₃, 100,000 IU; vitamin E, 4,000 IU; menadione, 00 mg; riboflavin, 1,000 mg; pantothenic acid, 2,500 mg; niacin, 5,500 mg; choline, 100,000 g; and vitamin B₁₂, 5 mg.

^cEach lb of selenium premix contains 272.4 mg Se.

^dEach lb of antibiotic premix contains 2.5 g carbadox.

Table 3. Particle Size Analysis of Diets Ground in a Hammermill with Two Screen Sizes

Item	Percentage sunflower oil seeds				
	0	15		25	
	3/16 in. diameter	1/8 in. diameter	3/16 in. diameter	1/8 in. diameter	3/16 in. diameter
Avg particle diameter, microns	667.16	610.40	662.47	570.38	615.78
Standard deviation of particle size	1.87	1.79	1.87	1.75	1.80
Surface area, cm ² /g	82.88	88.26	83.41	93.34	87.85
Number of particles per g	14,883	15,375	15,112	16,943	15,547

Table 4. Effect of Sunflower Seeds and Diet Particle Size on Performance of Nursery Pigs^a

Item	Percentage sunflower oil seeds				
	0	15		25	
	3/16 in. diameter	1/8 in. diameter	3/16 in. diameter	1/8 in. diameter	3/16 in. diameter
<u>0 to 14 d</u>					
ADG, lb	.55	.53	.52	.49	.44
ADFI, lb	.83 ^b	.77 ^b	.79 ^b	.69 ^c	.70 ^c
F/G		1.51	1.47	1.54	1.42
1.65					
<u>0 to 35 d</u>					
ADG, lb	.87 ^b	.83 ^{bc}	.84 ^b	.81 ^{bc}	.76 ^c
ADFI, lb	1.51 ^b	1.48 ^b	1.44 ^b	1.36 ^c	1.28 ^c
F/G	1.74	1.77	1.72	1.69	1.68

^aA total of 192 weaned pigs, 8 pigs/pen with 5 pens/treatment for the sunflower seed diets and 4 pens for the 0% sunflower seed diet; avg initial wt was 13.0 lb, avg final wt was 42.0 lb.

^{bc}Means with unlike superscripts differ (P<.05).