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Comparison of soybean oil and different sources of corn oil on nursery pig growth performance (2014)

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Comparison of Soybean Oil and Different Sources of Corn Oil on Nursery Pig Growth Performance

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Summary

A total of 350 pigs (PIC 1050; initially 26.45 ± 0.09 lb and 45 d of age) were used in a 21-d study to compare the effects of soy oil and 2 sources of corn oil on nursery pig growth performance. The 7 dietary treatments consisted of a corn-soybean meal–based control diet with no added oil or the control diet with 2.5 or 5% soybean oil (NE = 3,422 kcal/lb) or corn oil from 2 different sources (NE = 3,383 kcal/kg for both sources). There were 5 pigs per pen and 10 pens per treatment. Pig weight and feed disappearance were measured on day 0, 7, 14, and 21 of the trial to determine ADG, ADFI, and F/G.

Overall (d 0 to 21), increasing corn or soybean oil improved (linear; $P < 0.02$) ADG, F/G, and final (d-21) BW, but a source × level interaction was observed ($P < 0.05$) for ADG, F/G, and caloric efficiency (CE; caloric intake/total BW gain). For ADG, increasing soy oil or corn oil source 1 from 2.5 to 5% increased ADG, whereas increasing corn oil source 2 from 2.5 to 5% decreased ADG. Feed efficiency also improved at a greater rate for pigs fed increasing corn oil source 1 compared with the other oil sources. Caloric efficiency was not influenced by soy oil or corn oil source 2 but was improved (linear, $P < 0.05$) as corn oil source 1 increased in the diet. The improved CE for corn oil source 1 indicated that the energy value of this source was underestimated. In conclusion, soybean or corn oil improved ADG and F/G as expected; however, growth performance varied among the 3 oil sources. This study shows the benefits of adding an oil source in late-phase nursery pig diets to achieve improved ADG, F/G, and CE, but more research is needed to determine the cause of the varied responses between corn oil sources.

Key words: corn oil, growth performance, nursery pig, soybean oil

Introduction

Soybean oil can be added to nursery pig diets as a highly digestible source of energy, but feed manufactures often choose to include other sources of dietary energy because of the oil's high price. Corn oil is a more economical source of dietary fat than soybean oil because of increased oil extraction during the ethanol manufacturing process; however, few data are available to compare the impacts on growth performance of pigs fed diets containing soybean oil compared with corn oil. Furthermore, corn oil derived from different ethanol production facilities may influence pig growth performance differ-

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ently because of the oil extraction techniques utilized, but no data are available to test this assumption. Therefore, the objective of this study was to compare the influence of different corn oil sources and commercially available soybean oil on growth performance of nursery pigs.

Procedures

The protocol for this experiment was approved by the Kansas State University Institutional Animal Care and Use Committee. The study was conducted at the Kansas State University Segregated Early Weaning Facility in Manhattan, KS. The facility is a totally enclosed, environmentally controlled, mechanically ventilated barn. Each pen was equipped with a 4-hole stainless steel dry self-feeder and a cup waterer for ad libitum access to feed and water. Pens (4 × 4 ft) had wire-mesh floors and deep pits for manure storage.

A total of 350 pigs (PIC 1050; initially 26.45 ± 0.09 lb and 45 d of age) were used in a 21-d study. The 7 dietary treatments consisted of a corn-soybean meal–based control diet with no added oil or the control diet with 2.5 or 5% soybean oil (NE = 3,422 kcal/kg; NRC, 2012[2]) or corn oil from 2 sources (NE = 3,383 kcal/kg for both sources; NRC, 2012). Corn oil 1 was sourced from the Poet plant in Sioux Falls, SD, and corn oil 2 was from the Green Plains Renewable Energy plant in Shenandoah, IA. Commercially purchased soybean oil was from unknown sources. All diets were formulated to balance for the same lysine:ME ratio (Table 1). Diets were fed in meal form and were manufactured at the K-State O.H. Kruse Feed Technology Innovation Center. Pig weight and feed disappearance were measured on d 0, 7, 14, and 21 of the trial to determine ADG, ADFI, F/G, and caloric efficiency (caloric intake/total BW gain). There were 5 pigs per pen and 10 pens (replications) per treatment.

Samples of each oil source were collected at feed manufacturing and were analyzed for fatty acid profile; moisture, insoluble impurities and unsaponifiables (MIU); free fatty acids; and peroxide value. Samples were analyzed by NOVUS Laboratories, Inc. (St. Louis, MO). Multiple samples of each diet were collected from feeders, blended and subsampled, and submitted to Ward Laboratories, Inc. (Kearney, NE) for analysis of DM, CP, crude fat, Ca, and P (Table 2).

Data were analyzed as a randomized complete block design using PROC MIXED in SAS (SAS Institute, Inc., Cary, NC) with pen as the experimental unit. Barn was used as a blocking factor, and block within barn was included in the model as a random effect. Results from the experiment were considered significant at $P < 0.05$ and a tendency between $P > 0.05$ and $P \leq 0.10$.

Results and Discussion

Complete diet analysis was similar to formulated nutrient levels. Quality characteristics of the 3 oil sources (Table 3) showed variation in some of the measurements. For free fatty acids, soybean oil, as expected, was very low, with corn oil having higher levels but not to the degree of concern for swine diets. In initial peroxide value, however, soybean oil had an elevated level that was much higher than general guidelines for fats for swine, and MIU exhibited minor differences among oil sources.

[2] NRC, 2012. Nutrient Requirements of Swine, 11th ed. Natl. Acad. Press, Washington DC.

For overall growth performance(d 0 to 21), increasing corn or soybean oil improved (linear; $P < 0.02$) ADG, F/G, and final (d 21) BW; however, a source × level interaction was observed ($P < 0.05$) for ADG, F/G, and caloric efficiency (Table 4). For ADG, increasing soybean oil or corn oil source 1 from 2.5 to 5% increased ADG, whereas increasing corn oil source 2 from 2.5 to 5% decreased ADG. The interaction for F/G was because F/G improved at a greater rate for pigs fed increasing levels of corn oil source 1 compared with the other oil sources. Caloric efficiency was not influenced by soy oil or corn oil source 2 but improved (linear, $P < 0.05$) as corn oil source 1 increased in the diet. The improved CE for corn oil source 1 indicated that the net energy value of this source was underestimated in diet formulation.

In conclusion, soybean or corn oil increased ADG and F/G as expected. Our data also suggest that there may be differences in corn oil sources, and additional research should be conducted to further define the impact of corn oil source on growth performance of pigs. Overall, this study confirms the benefits of adding an oil source in late-phase nursery pig diets to achieve improved ADG and F/G.

Table 1. Diet composition (as-fed basis)[1]

Ingredient, %	Control	2.5% oil	5% oil
Corn	63.58	58.56	53.52
Soybean meal (46.5% CP)	32.65	35.20	37.75
Oil source[2]	--	2.50	5.00
Monocalcium phosphate, (21% P)	1.30	1.28	1.28
Limestone	1.08	1.08	1.05
Salt	0.35	0.35	0.35
L-lysine-HCl	0.32	0.31	0.30
DL-methionine	0.13	0.14	0.15
L-threonine	0.12	0.12	0.13
Trace mineral premix	0.15	0.15	0.15
Vitamin premix	0.25	0.25	0.25
Phytase[3]	0.08	0.08	0.08
Total	100.00	100.00	100.00
Calculated analysis			
Standardized ileal digestible (SID) amino acids, %			
Lysine	1.23	1.28	1.33
Isoleucine:lysine	62	63	63
Leucine:lysine	128	126	124
Methionine:lysine	34	34	34
Met & Cys:lysine	57	57	57
Threonine:lysine	63	63	63
Tryptophan:lysine	18.4	18.7	19.0
Valine:lysine	68	68	68
Total lysine, %	1.38	1.43	1.49
ME, kcal/lb	1,478	1,536	1,594
NE NRC, kcal/lb	1,089	1,137	1,186
SID lysine:ME, g/Mcal	3.77	3.78	3.78
CP, %	21.3	22.1	22.9
Ca, %	0.73	0.73	0.73
P, %	0.68	0.68	0.68
Available P, %	0.45	0.45	0.45

[1] Experimental diets were fed for 21 d beginning approximately 42 d after weaning.
[2] Corn oil source 1 (Poet, Sioux Falls, SD), Corn oil source 2 (Green Plains Renewable Energy, Shenandoah, IA), and soybean oil were commercially contracted.
[3] Natuphos 600 (BASF, Florham Park, NJ) provided 204.3 phytase units (FTU)/lb, with a release of 0.09% available P.

Table 2. Chemical analysis of experimental diets[1]

		Added oil, %					
	Control	Soybean oil		Corn oil 1[2]		Corn oil 2[3]	
Item	0	2.5	5	2.5	5	2.5	5
DM, %	89.87	90.38	90.59	90.38	90.62	90.64	90.57
CP, %	21.90	22.80	23.70	21.60	23.40	22.50	23.20
Ca, %	1.05	0.90	0.89	1.03	1.06	0.92	0.98
P, %	0.69	0.64	0.70	0.67	0.71	0.65	0.65
Crude fat, %	2.80	4.90	7.20	4.90	7.70	4.40	5.70

[1] Multiple samples were collected from each diet throughout the study, homogenized, then subsampled for analysis at Ward Laboratories, Inc. (Kearney, NE).
[2] Corn oil source 1 (Poet, Sioux Falls, SD).
[3] Corn oil source 2 (Green Plains Renewable Energy, Shenandoah, IA).

Table 3. Chemical analysis of oil sources[1]

Item	Soybean oil	Corn oil 1[2]	Corn oil 2[3]
Free fatty acids, %	0.16	4.10	11.80
Initial peroxide value, (meq/kg)	47.60	1.00	5.60
Moisture, %	0.05	0.55	0.45
Insoluble impurities, %	0.03	0.07	0.02
Unsaponifiables, %	0.53	1.76	1.86

[1] Samples were analyzed by NOVUS Laboratories, Inc. (St. Louis, MO).
[2] Corn oil source 1 (Poet, Sioux Falls, SD).
[3] Corn oil source 2 (Green Plains Renewable Energy, Shenandoah, IA).

Table 4. Comparison of different levels and sources of oil on nursery pig performance[1]

		Added oil, %							Probability, $P <$					
	Control	Soybean oil		Corn oil 1[2]		Corn oil 2[3]			Soybean oil		Corn oil 1		Corn oil 2	
Item	0	2.5	5	2.5	5	2.5	5	SEM	Linear	Quadratic	Linear	Quadratic	Linear	Quadratic
d 0 to 21														
ADG, lb[a]	1.39	1.50	1.53	1.46	1.48	1.46	1.44	0.028	<0.01	0.196	0.020	0.562	0.199	0.236
ADFI, lb[a,b]	2.23	2.26	2.22	2.16	2.08	2.16	2.08	0.045	0.939	0.482	0.020	0.959	0.025	0.898
F/G[b]	1.60	1.51	1.46	1.48	1.40	1.49	1.44	0.025	<0.01	0.347	<0.01	0.513	<0.01	0.152
BW, lb														
d 0	26.49	26.39	26.45	26.40	26.40	26.39	26.41	0.813	0.832	0.650	0.678	0.772	0.692	0.73
d 21[a]	55.78	58.28	58.48	56.99	57.69	56.97	56.70	0.824	0.005	0.149	0.045	0.745	0.330	0.360
CE[4bc]	1,740	1,712	1,726	1,682	1,663	1,689	1,714	63.930	0.645	0.428	0.013	0.446	0.381	0.143

[1] A total of 350 pigs (PIC 1050) were used in a 21-d study with 5 pigs per pen and 10 pens per treatment.
[2] Corn oil source 1 (Poet, Sioux Falls, SD).
[3] Corn oil source 2 (Green Plains Renewable Energy, Shenandoah, IA).
[4] Caloric efficiency = Kcal of NE per pound of gain ((ADFI × NE/lb) /ADG)).
[a] Source × level interaction (soybean oil × corn oil 1); $P < 0.05$.
[b] Source × level interaction (soybean oil × corn oil 2); $P < 0.05$.
[c] Source × level interaction (corn oil 1 × corn oil 2); $P < 0.10$.