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D B. Jones

Jim L. Nelssen

Robert H. Hines

See next page for additional authors

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D B. Jones, Jim L. Nelssen, Robert H. Hines, and Joe D. Hancock

EFFECTS OF LECITHIN AND LYSOLECITHIN ADDITIONS ON GROWTH PERFORMANCE AND NUTRIENT DIGESTIBILITY IN WEANLING PIGS[1]

D. B. Jones, J. D. Hancock, J. L. Nelssen, and R. H. Hines

Summary

Two hundred seventy pigs (21 d of age and 12.8 lb initial wt) were used to determine if adding emulsifiers (lecithin and lysolecithin) to starter pig diets affects growth performance and digestibility of nutrients. Treatments were: 1) corn-soy control; 2) diet 1 with soybean oil; 3) diet 1 with tallow; 4, 5, and 6) diet 3 with lecithin replacing 5%, 10%, and 30% of the tallow; 7, 8, and 9) diet 3 with lysolecithin replacing 5%, 10%, and 30% of the tallow. Average daily gain (ADG), average daily feed intake (ADFI), and feed/gain ratio (F/G) were determined weekly during the 35-d experiment. Apparent digestibilities of total fat, unsaturated and saturated fatty acids, nitrogen, and gross energy were determined from fecal samples collected on d 14. The digestibilities of total fat, unsaturated fatty acids and saturated fatty acids were greater for soybean oil than for tallow. The addition of lecithin to tallow improved digestibility, especially the digestibility of saturated fatty acids. The addition of lysolecithin did not improve the digestibility of tallow. At d 14, ADG and ADFI were not affected by treatment. From d 14 to 35, control pigs had poorer F/G than pigs fed the different fat sources. Average daily gain and ADFI were increased when lecithin and lysolecithin were added to the tallow diet. For the entire experiment, ADG was not affected by treatment, although there was a tendency for improved ADG when the emulsifiers were added to the tallow. Feed intake was greater and F/G poorer for control pigs than pigs fed the fat sources. Our results indicate that the addition of lecithin increased the digestibility of tallow, and ADG and ADFI were improved the last 3 wk of the 5-wk experiment when emulsifiers were added to tallow.

(Key Words: Lecithin, Lysolecithin, Growth Performance, Nutrient Digestibility, Nursery Pigs.)

Introduction

Fat additions to diets for weanling pigs are used to increase the caloric density of these diets. The source of fat used for this purpose will affect how well the added calories are utilized. Soybean oil has a digestibility of approximately 90%, which is usually attributed to its high percentage of unsaturated fatty acids. Tallow and lard, on the other hand, have lower values for digestibility (80 to 85%), usually attributed to their high concentrations of long chain, saturated fatty acids. Soybean oil is about twice as expensive as these other fat sources because of demand for its use in human foods. Therefore, there is a need to increase the digestibility of the less expensive fat sources. Lecithin and lysolecithin, by-products of soybean oil processing, have the ability to increase the dispersibility of fats in water. Increased dispersion of fat droplets in the watery contents of the pig's gut may increase the ability of enzymes to

[1]Lecithin products donated by Central Soya Company, Inc., Fort Wayne, Indiana.

digest that fat. The objective of this experiment was to determine the effects of adding lecithin and lysolecithin to starter diets containing tallow as a fat source.

Experimental Procedures

A total of 270 pigs (21 d of age and 12.8 lb initial wt) were used in a 5-wk growth assay. Pigs were housed (six per pen) in an environmentally controlled nursery with 4 ft × 5 ft pens and woven wire flooring. Each pen was equipped with a self-feeder and nipple waterer, so that feed and water were supplied ad libitum.

Pigs were fed the Phase 1 diets (Table 1) to d 14 then switched to the Phase 2 diets (Table 2) for the remainder of the experiment. Phase 1 treatments were: 1) corn-soy control; 2) diet 1 with 10% soybean oil; 3) diet 1 with 10% tallow; 4, 5, and 6) diet 3 with lecithin replacing 5%, 10%, and 30% of the tallow; 7, 8, and 9) diet 3 with lysolecithin replacing 5%, 10%, and 30% of the tallow. Phase 2 treatments were the same as Phase 1 treatments, but contained 5% added fat and no dried skim milk.

Table 1. Experimental Diets (Phase 1)[a]

Ingredients, %	Control	Soybean oil
Corn	36.76	25.81
Soybean meal (48%)	20.32	21.20
Dried skim milk	20.00	20.00
Dried whey	20.00	20.00
Soybean oil[b]	--	10.00
Monocalcium phosphate	1.00	1.12
Limestone	.57	.51
Lysine-HCl	.10	.10
Vitamins, minerals, antibiotic	1.00	1.00
Chromic oxide	.25	.25
Total	100.00	100.00

[a]Calculated analysis was 1.5% lysine, .9% calcium, .8% phosphorus.

[b]Soybean oil was replaced with tallow, tallow with 5%, 10%, and 30% lecithin, and tallow with 5%, 10%, and 30% lysolecithin for treatments 3 to 9, respectively.

Pigs and feeders were weighed weekly to determine average daily gain (ADG), average daily feed intake (ADFI), and feed to gain ratio (F/G). On d 13 and 14 of the experiment, fecal samples were collected from the pigs. The samples were pooled within pen; dried; and analyzed for nitrogen, dry matter, gross energy, fatty acids, total fat, and chromium content.

Results and Discussion

The digestibilities of total fat, unsaturated fatty acids, and saturated fatty acids were greater for soybean oil than for tallow (Table 3). The addition of lecithin to the tallow increased digestibility, especially the digestibility of saturated fatty acids. Tallow was more digestible when lecithin was the emulsifier than when lysolecithin was the emulsifier ($P<.005$). Nitrogen digestibility was improved ($P<.001$) when the fat sources were added to the corn-soybean meal control diet. Energy digestibility was improved when soybean oil, tallow, and

tallow plus lecithin were added to the diets, but adding lysolecithin to the tallow decreased energy digestibility (P<.007).

From d 0 to 14, ADG and ADFI were not affected (P>.10) by dietary treatment (Table 4). From d 14 to 35, pigs fed the control diet converted feed less efficiently than pigs given the diets containing fat (P<.001). Average daily gain (P<.10) and ADFI (P<.07) were improved when the emulsifiers were added to diets containing tallow.

From d 0 to d 35, ADFI was greater (P<.05) and F/G was poorer (P<.002) for pigs fed the control diet. Average daily gain was not affected by treatment (P>.10).

Based on these data, we conclude that adding emulsifiers to weanling pig diets will increase the digestibility of tallow. An increase in growth performance was evident from the third to fifth week postweaning, when lecithin or lysolecithin was added to the tallow.

Table 2. Experimental Diets (Phase 2)[a]

Ingredient, %	Control	Soybean oil
Corn	48.75	43.20
Soybean meal (48%)	27.57	28.10
Dried whey	20.00	20.00
Soybean oil[b]	--	5.00
Monocalcium phosphate	1.58	1.65
Limestone	.90	.86
Lysine-HCl	.10	.10
Vitamins, minerals, antibiotic	1.10	1.10
Total	100.00	100.00

[a]Calculated analysis was: 1.25% lysine, .9% calcium, .8% phosphorus.

[b]Soybean oil was replaced with tallow, tallow with 5%, 10%, and 30% lecithin, and tallow with 5%, 10%, and 30% lysolecithin for treatments 3 to 9, respectively.

Table 3. Effect of Lecithin and Lysolecithin on Fat Digestibility[a]

Item, %	Control	Soybean oil	Tallow	Percentage of tallow as lecithin 5	10	30	Percentage of tallow as lysolecithin 5	10	30	CV
Total fat digestibility[b]	89.1	93.1	84.5	87.6	87.2	87.5	82.5	83.7	85.8	3.6
Unsaturated fatty acid digestibility[cd]	92.6	95.9	94.5	94.5	94.7	95.0	92.9	93.8	94.0	1.4
Saturated fatty acid digestibility[ef]	78.4	79.4	71.8	78.8	77.3	75.3	69.2	70.5	72.7	9.9
Nitrogen digestibility[g]	83.3	86.6	88.2	88.6	87.7	87.7	85.4	87.1	86.2	2.2
Energy digestibility[h]	87.5	89.9	89.1	89.9	88.9	89.3	86.7	87.7	87.6	2.2

[a]Determined on d 14 by the indirect ratio method.
[b]Control vs all other treatments ($P<.09$); soybean oil vs tallow plus emulsifiers ($P<.001$); lecithin vs lysolecithin ($P<.005$).
[c]Fatty acids were C 16:1, 18:1, 18:2, 18:3.
[d]Control vs all other treatments ($P<.008$); soybean oil vs tallow plus emulsifiers ($P<.01$); lecithin vs lysolecithin ($P<.03$).
[e]Fatty acids were C 14, 16, 18.
[f]Lecithin vs lysolecithin ($P<.03$).
[g]Control vs all other treatments ($P<.001$); lecithin vs lysolecithin ($P<.02$).
[h]Lecithin vs lysolecithin ($P<.007$).

Table 4. Effect of Lecithin and Lysolecithin on Growth Performance[a]

Item	Control	Soybean oil	Tallow	Percentage of tallow as lecithin 5	10	30	Percentage of tallow as lysolecithin 5	10	30	CV
d 0 to 14										
ADG, lb[b]	.87	.80	.75	.80	.75	.71	.75	.71	.74	10.8
ADFI, lb[c]	.90	.79	.77	.79	.75	.71	.73	.75	.73	10.5
F/G[d]	1.02	1.02	1.04	1.00	1.01	1.01	.97	1.07	.98	5.0
d 14 to 35										
ADG, lb[e]	1.21	1.27	1.20	1.25	1.21	1.29	1.31	1.30	1.29	7.6
ADFI, lb[f]	2.03	1.99	1.84	1.95	1.90	2.00	1.98	2.01	2.01	7.3
F/G[g]	1.68	1.57	1.54	1.57	1.57	1.55	1.51	1.54	1.56	3.7
d 0 to 35										
ADG, lb[h]	1.07	1.08	1.02	1.07	1.03	1.06	1.09	1.06	1.07	6.6
ADFI, lb[i]	1.58	1.51	1.41	1.49	1.44	1.49	1.48	1.50	1.50	6.8
F/G[j]	1.49	1.41	1.39	1.40	1.40	1.41	1.36	1.41	1.40	3.1

[a]270 pigs, 6 pigs/pen, 5 pens/treatment.
[b]No treatment effect (P>.50).
[c]No treatment effect (P>.10).
[d]Quadratic effect of emulsifier percentage (P<.03); lecithin vs lysolecithin × percentage (P<.06).
[e]Tallow vs tallow plus emulsifiers (P<.10).
[f]Tallow vs tallow plus emulsifiers (P<.07).
[g]Control vs all other treatments (P<.001).
[h]No treatment effect (P>.10).
[i]Control vs all other treatments (P<.05).
[j]Control vs all other treatments (P<.002).