EXOGENOUS EMULSIFIERS IN EARLY WEANED PIG DIETS

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Story in Brief

Two growth trials involving 144 pigs (21 d of age) were conducted to determine the efficacy of emulsifiers for improving utilization of fat in a three-phase starter feeding regime. Phase 1 consisted of d 0 to 7, Phase 2 from d 7 to 21, and Phase 3 from d 21 to 35 postweaning. During each phase pigs were fed one of the following diets: 1) basal control diet containing 4% lard and 4% soy oil, 2) basal diet with .1% lysoforte, or 3) basal diet with .02% lysoprin. Blood samples were collected on d 7 and 21 postweaning and sera was analyzed for triglycerides and nonesterified fatty acids. From d 0 to 7 postweaning, the addition of lysoforte and lysoprin to the starter pig diet did not affect average daily gain, average daily feed intake or feed efficiency. From d 7 to 14 , however, pigs fed lysoforte and lysoprin had improved gains of 10.4% and 7.3%, respectively, compared with those fed the control diet. Similarly, pigs fed lysoforte and lysoprin consumed 10.8% and 8.6% more feed, respectively, than those fed the control diet. Average daily gain, average daily feed intake and feed efficiency were similar among treatment groups during d 7 to 21, and from d 21 to 35. Serum triglycerides tended to decrease with the addition of lysoforte and lysoprin to the diet. Serum nonesterified fatty acids, however, were not affected by dietary treatments. These results indicate that the addition of lysoforte and lysoprin to young pig diets containing 4% lard and 4% soy oil as the fat source tended to improve performance and to reduce serum triglyceride levels.

(Key Words: Early-Weaned Pig, Lysoforte, Lysoprin, Emulsifier, Performance.)

Introduction

Since the dry matter of sow's milk contains about 35% fat (Frobish et al., 1969), it has been suggested that young pigs should utilize fat very well. Numerous attempts to improve performance in early weaning pigs by the inclusion of high levels of dietary fat, however, have not consistently improved performance. In fact, Cera et al. (1988) indicated that utilization of dietary fat by the young pig, particularly during the early postweaning period, is limited due to insufficient fat digestion and absorption. The authors also demonstrated that animal fats are less digestible than vegetable fats. Limited utilization of animal fat has been attributed to a high content of long-chain, saturated fatty

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acids that have a restricted entry into the micellar phase (Freeman, 1969). Because emulsification is required for micellar formation and absorption of fat, exogenous emulsifiers may enhance fat utilization by the young pig fed high-fat diets. Therefore, the objective of this study was to determine the effect of two emulsifiers (lysoforte and lysoprin) on performance of early weaned pigs, and on serum triglycerides and nonesterified fatty acids.

Materials and Methods

Two trials involving a total of 144 Yorkshire, Hampshire, and Yorkshire x Hampshire pigs (21 d old and 12.4 lb average initial body weight) were conducted to evaluate the use of lysoforte and lysoprin as fat emulsifiers in a three-phase nursery feeding program. Pigs were grouped by sex and stratified by litter and weight to pens containing six pigs. Pens from each sex group were randomly assigned to one of three treatments consisting of 1) a basal diet containing 4% lard and 4% soy oil (control; Table 1); 2) the basal diet with .1% lysoforte; or 3) the basal diet with .02% lysoprin (liquid emulsifier). Lysoprin was homogenized with the fat source prior to mixing. The basal diet was changed in each of the three feeding phases. The Phase 1 basal diet was fed from d 0 to 7 postweaning and formulated to contain 1.46% lysine, .94% Ca, and .8% P. The Phase 2 basal diet was fed from d 7 to 21 postweaning and was formulated to contain 1.35% lysine, .9% Ca and .7% P, and the Phase 3 basal diet was fed from d 21 to 35, and was formulated to contain 1.15% lysine, .8% Ca and .7% P. Lysoforte and lysoprin were substituted for an equal quantity of corn in the basal diets.

Pigs were housed in environmentally regulated nursery in pens (4'11" x 5') with woven wire flooring. The initial temperature of 86°F was subsequently decreased 2°F per week. Pigs had ad libitum access to one nipple waterer and a five-hole feeder. Pigs body weight and feed intake were determined weekly to evaluate average daily gain (ADG), average daily feed intake (ADFI), and feed efficiency (feed/lb gain). Blood samples were taken via anterior vena cava puncture on d 7 and 21 of the trial, and analyzed for serum triglycerides (The Roche Reagent for Triglycerides, Roche, Nutley, NJ) and nonesterified fatty acids (NEFA-C kit, Wako Chemicals USA, Dallas, TX).

Performance data were analyzed by least square analysis of variance with trial, sex, treatment, and all the appropriate interactions in the model. Pen was considered the experimental unit. Orthogonal comparisons were 1) control versus lysoforte and lysoprin, and 2) lysoforte versus lysoprin. Serum triglyceride and nonesterified fatty acids data were analyzed by split plot analysis of variance with treatment as the main plot and sampling day as a subplot, and all appropriate interactions.

Results and Discussion

No trial x treatment or sex x treatment interactions were observed, therefore data from both trials and both sexes within trial were combined for analysis. From d 0 to 7 postweaning, the addition of emulsifiers to the starter diet did not affect ADG, ADFI or feed/gain (Table 2) although a numerical improvement in gain and efficiency was observed ($P<.2$). From d 7 to 14, however, pigs fed emulsifiers tended to grow faster ($P<.1$) and had higher feed intakes ($P<.01$) than those fed the control diet (Table 2). The magnitude of response ranged from a 10.4% increase in ADG in pigs fed lysoforte to a 7.3% increase in ADG in pigs fed lysoprin when compared with the control diet. There was no significant emulsifier effect on feed efficiency. From d 7 to 21 and 21 to 35, ADG, ADFI and feed efficiency were not affected by treatment (Table 2). No differences were observed between lysoforte and lysoprin in any of the performance criteria measured during the growth phases.

Research investigating the effect of emulsifiers on performance of weanling pigs is limited and inconsistent (Fobrish et al., 1969; Jones et al., 1992; Øverland et al., 1993). Øverland et al. (1993) reported no improvement in soy oil digestibility or growth by addition of lecithin (as an emulsifier) to diets of young pigs. Jones et al. (1992), on the other hand, reported that emulsifiers increased digestibility of nutrients in the young pig, but had minimal effect on growth. The fat source used in the present study was a combination of lard and soy oil. Because vegetable fats are more digestible than animal fats (Cera et al., 1989), it is possible that the addition of soy oil improved the digestibility of total fat and therefore, the effect of lysoforte and lysoprin was limited. The use of emulsifiers in weaning pig diets may be more beneficial when used with less digestible fats (e.g., animal fats alone). Previous studies, however, reported that lecithin increased digestibility of tallow, but decreased the digestibility of lard (Jones et al., 1992).

The feeding of lysoforte and lysoprin tended to lower ($P<.1$) serum triglycerides compared with the feeding of the control diet (Table 3). Jones et al. (1992) also observed that pigs fed tallow plus emulsifiers had lower serum triglycerides than pigs fed tallow without emulsifiers. Why emulsifiers decreased serum triglycerides concentrations is unclear. Jones et al. (1992) suggested that because fat digestibility increased and serum triglycerides decreased when pigs were fed lecithin in their study, the resulting chylomicrons were either cleared from the blood at a faster rate or secreted into the blood at a slower rate. Serum triglyceride levels were higher on d 21 than on day 7 in all treatments groups ($P<.0001$). Serum nonesterified fatty acids were not affected by dietary treatments (Table 3). This is consistent with the findings of Jones et al. (1992) who observed no differences in serum free fatty acids between pigs fed tallow and those fed tallow plus emulsifiers.

In general, these results indicate that the addition of lysoforte and lysoprin to young pig diets containing lard and soy oil as the fat source tended to improve growth and feed intake, and tended to reduce serum triglycerides. Effects on feed efficiency were minimal.

Literature Cited

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Table 1. Composition of basal diets.

	Diets[a]		
	Phase 1	Phase 2	Phase 3
Ingredient, %	Day 0 to 7	Day 7 to 21	Day 21 to 35
AP-820[b]	4.00		
Whey, dehydrated	20.00		
Lactose, 97%		10.00	
Soybean oil	4.00	4.00	4.00
Lard	4.00	4.00	4.00
AP-300[c]	1.50	2.50	
Soybean meal, 44%		25.00	27.00
Corn, ground	42.97	46.31	61.30
Endox[d]	.03	.03	.03
Micro curb	.10	.10	.10
Lysine, HCl	.26	.10	.25
Fishmeal	7.00		
Fish analog		5.00	
DL-Methionine	.09		
CTC-50[e]	.20	.20	.20
$CuSO_4$	.07	.08	.05
Calcium carbonate		.35	.55
Vit. min. premix[f]	.38	.38	.25
Dicalcium phosphate	1.30	1.35	1.85
Profine E	4.00		
Salt	.10	.30	.42
Steam rolled oats	10.00		
Zinc oxide		.30	

[a] As fed basis. Diets were formulated to contain 1.46% lysine, .94% Ca, and .8% P in Phase 1; 1.35% lysine, .9% Ca, and .7% P in Phase 2; 1.15% lysine, .8% Ca, and .7% P in Phase 3, and to exceed the NRC (1988) standards for all nutrients.

[b] Plasma protein source, American Protein Corp., Ames, IA.

[c] Blood meal source, American Protein Corp., Ames, IA.

[d] Kemin, industries.

[e] Contained 110 g chlorotetracycline per kg.

[f] Vitamins and minerals met or exceed the NRC (1988) requirements.

Table 2. Effect of lysoforte and lysoprin on growth performance of weanling pigs fed diets with added lard and soy oil.[a]

Item	Treatments			SEM
	Control	Lysoforte	Lysoprin	
No. of pigs	48	48	48	
No. of pens	8	8	8	
Initial wt, lb	12.42	12.35	12.38	.1
Final wt, lb	42.69	41.43	42.48	.9
Day 0 to 7				
Average daily gain, lb	.41	.46	.44	.03
Average daily feed intake, lb	.41	.44	.44	.02
Feed efficiency, feed/gain	1.02	.97	.99	.06
Day 7 to 14				
Average daily gain, lb[b]	.67	.74	.72	.03
Average daily feed intake, lb[c]	.93	1.03	1.01	.03
Feed efficiency, feed/gain	1.43	1.41	1.43	.05
Day 7 to 21				
Average daily gain, lb	.82	.81	.82	.04
Average daily feed intake, lb	1.19	1.22	1.22	.07
Feed efficiency, feed/gain	1.46	1.53	1.50	.05
Day 21 to 35				
Average daily gain, lb	1.08	1.04	1.10	.08
Average daily feed intake, lb	2.02	1.97	2.03	.10
Feed efficiency, feed/gain	1.87	1.88	1.87	.06

[a] Values are least squares means.

[b] Control vs lysoforte and lysoprin ($P<.1$).

[c] Control vs lysoforte and lysoprin ($P<.01$).

Table 3. Effect of lysoforte and lysoprin on serum triglycerides and nonesterified fatty acids (NEFA) in weanling pigs fed diets with added lard and soy oil[a].

	Treatments			
Item	Control	Lysoforte	Lysoprin	SEM
Triglycerides, mg/dL[bc]				
Day 7	48.07	46.97	40.35	3.13
Day 21	63.28	57.33	61.62	3.13
NEFA, µEq/L[d]				
Day 7	173.18	172.61	147.85	11.52
Day 21	141.06	133.44	131.56	11.52

[a] Values are least squares means.
[b] Control vs lysoforte and lysoprin ($P<.1$).
[c] Day effect ($P<.0001$).
[d] Day effect ($P<.005$).