EFFECT OF PROTEIN AND FAT SOURCE ON PERFORMANCE IN EARLY WEANED PIGS

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Story in Brief

A study involving 144 Yorkshire, Hampshire and Yorkshire x Hampshire crossbred early weaned pigs was conducted to determine the effects of protein and fat source on performance in pigs fed complex prestarter diets. Pigs were group weaned at 21 to 28 days of age and randomly allotted to one of four dietary treatments in a 2 X 2 factorial experiment. Diets were: 1) diet containing plasma protein with 8% added medium-chain triglycerides as the fat source; 2) Diet 1 with 8% soy oil as the fat source; 3) diet containing soybean meal with 8% added medium-chain triglycerides as the fat source and 4) Diet 3 with 8% added soy oil as the fat source. Experimental prestarter diets were fed for two weeks (Period 1), followed by feeding a common starter diet for three weeks (Period 2). Weekly gain and feed intake measurements were recorded. This study shows that early weaned pigs fed a diet containing plasma proteins had superior performance when compared to pigs fed a diet with soybean meal. Replacing soy oil with medium-chain triglycerides in both prestarter diets resulted in reduced average daily gain for weeks 1 and 2 and for the total experiment.

(Key Words: Early Weaning, Plasma Protein, Medium-Chain Triglycerides.)

Introduction

Addition of fat to early weaned pig diets has resulted in conflicting results. Factors including source of fat, inclusion rate, energy:protein ratio, protein source, carbohydrate source and performance level influence the magnitude and level of the response to added fat. Most fat sources used in swine diets are composed of long-chain fatty acids (triglycerides) derived from plants or animals. Cera et al. (1989) reported that digestibility of triglycerides containing medium-chain fatty acids was higher than that of triglycerides containing long-chain fatty acids. Medium-chain triglycerides are made up of a mixture of C6:0, C8:0, C10:0 and C12:0 medium-chain fatty acids esterified

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to glycerol. Medium-chain triglycerides are hydrolyzed faster and more completely within the intestinal lumen than long-chain triglycerides. Medium-chain fatty acids (products of hydrolysis of medium-chain triglycerides) are absorbed at a faster rate from the intestinal lumen than long-chain fatty acids. Fatty acids with medium-chain length enter the portal blood directly upon absorption and thus reach the liver more rapidly than long-chain fatty acids. Dietary fats containing medium-chain triglycerides may be utilized more effectively than fats composed of long-chain fatty acids. De Rodas et al. (1990) observed increased performance with increasing levels of medium-chain triglycerides up to six percent of the diet.

Although early-weaned pigs can grow consuming a corn-soybean starter diet, performance can be enhanced by incorporating alternate sources of protein into the diet. It has been shown that feeding early weaned pigs a diet containing soybean meal results in decreased growth performance, lowered villus height, increased serum anti-soy IgG titers and decreased absorptive capacity (Li et al., 1991). This suggests that diet or protein source may affect the utilization of other nutrients.

This study was conducted to compare the effects of protein and fat source on performance of early weaned pigs.

Materials and Methods

One hundred forty-four Yorkshire, Hampshire and Yorkshire x Hampshire crossbred pigs (72 pigs in each of two replications) were group weaned at 21 to 28 days of age and stratified by weight, litter and sex to pens with six pigs per pen. Each pen was randomly assigned to one of four treatments (Table 1). Dietary treatments during the first 14 days postweaning (Period 1) consisted of: 1) diet containing plasma protein with 8% added medium-chain triglycerides as the fat source; 2) Diet 1 with 8% soy oil as the fat source; 3) diet containing soybean meal with 8% added medium-chain triglycerides as the fat source and 4) Diet 3 with 8% added soy oil as the fat source. Diets were formulated to contain 20% edible grade whey, 10% dried skim milk and 1.4% lysine. All pigs were fed a common starter diet (Table 1) for an additional 3 weeks (Period 2) to evaluate any carry-over effects on performance from diets fed during period 1. Pigs were housed in an environmentally controlled room in elevated pens with ad libitum access to both feed and water. A temperature of 84 to 86° F was maintained during week 1 and was decrease 2° F per week for the remainder of the experiment. Pen was used as the experimental unit in all statistical analyses.

Table 1. Composition of diets[a].

Ingredient	Period 1		Period 2
	SBM	Plasma protein	
Dried skim milk	10.0	10.0	--
Whey (Edible grade)	20.0	20.0	--
Corn	38.4	46.2	66.65
AP-820[b]	--	6.8	--
Soybean meal, 44%	15.0	--	28.5
Fat source[c]	8.0	8.0	--
Lysine, HCl	.25	.25	.15
Fishmeal, Menhaden	5.0	5.0	--
Ethoxyquin	.025	.025	--
FOA 390[d]	1.0	1.0	1.0
Flavor, Berry	.1	.1	--
Copper sulphate	.1	.1	.075
DL-Methionine	.2	--	--
Vitamin trace mineral premix[e]	.74	.74	.375
Calcium carbonate	--	--	.90
Dicalcium phosphate	1.35	1.75	--
Salt	--	--	.40
Calculated composition of diet			
Metabolizable energy (Mcal/lb)	1.62	1.62	1.45
Crude protein (%)	19.40	18.21	18.32
Lysine (%)	1.40	1.40	1.11
Tryptophan (%)	.25	.25	.24
Threonine (%)	.86	.91	.72
Methionine + Cysteine (%)	.70	.72	.61
Calcium (%)	.99	1.07	.88
Posphorous (%)	.85	.85	.74

[a] As fed basis.

[b] Plasma protein source, American Protein Corporation, Ames, Iowa.

[c] Medium chain triglyceride (MCT) or soy oil.

[d] Provided 10 g Furazolidone, 5 g Oxytetracycline, 4.5 g Arsanilic acid per lb of diet.

[e] Supplied 4,160 IU vitamin A, 416 IU vitamin D, 18 IU vitamin E, 20 mg pantothenic acid, 28 mg niacin, 4.0 mg riboflavin, 7.3 mg menadione sodium bisulfate, .02 mg vitamin B_{12}, 1.3 mg biotin, 2.7 mg pyridoxine, .9 mg folic acid, 3.9 mg thiamin, 267 mg choline, .1 mg selenium, .03 g manganese, .1 g zinc, .1 g iron, .1 g copper, .2 g magnesium, .43 g potassium and .2 mg iodine per lb of feed in Period 1 and 3,000 IU vitamin A, 300 IU vitamin D, 12.8 IU vitamin E, 15 mg pantothenic acid, 20.3 mg niacin, 3.0 mg riboflavin, .01 mg vitamin B_{12}, 193 mg choline, .07 mg selenium, .02 g manganese, .07 g zinc, .07 g iron, .07 g copper and .17 mg iodine per lb of feed in Period 2.

Results and Discussion

Main effect means are presented except in instances where a protein source by fat source interaction ($P<.1$) was observed. Least squares means for average daily gain are presented in Table 2. For weeks 1 and 2 and during period 1, pigs fed the complex prestarter diets containing plasma protein grew 30, 11 and 15% faster ($P<.05$), respectively than pigs fed diets with soybean meal. In contrast, pigs receiving diets containing soybean meal during period 1 grew 24% faster ($P<.05$) during week 3 (the first week that a common corn-soybean meal diet was fed) than pigs receiving the diets with plasma protein in period 1. This suggests that adaptation to soybean protein was still necessary two weeks postweaning in pigs that were fed diets devoid of soybean proteins. Pigs fed diets containing the soy oil grew 27, 21 and 24% faster ($P<.05$) during week 1, week 2 and period 1 respectively, than pigs consuming diets containing medium-chain triglycerides. Rate of gain was similar among treatments during weeks 4, 5 and period 2. However, pigs receiving diets containing soy oil during period 1 grew 9% faster ($P<.05$) during the total experiment than pigs fed the medium-chain triglyceride fat source.

Average daily feed intake during week 2 and period 1 was 15 and 11% lower ($P<.05$) respectively, in pigs fed diets with soybean meal compared to

Table 2. Effect of protein and fat source on average daily gain (lb)[a].

	Protein source		Fat source	
Item	AP-820	SBM	MCT	Soy oil
Week 1	.39[b]	.30[c]	.30[d]	.38[e]
Week 2	.84[d]	.76[e]	.72[d]	.87[e]
Period 1	.61[d]	.53[e]	.51[b]	.63[c]
Week 3	.71[b]	.88[c]	.76	.82
Week 4	1.01	.97	.97	1.00
Week 5	1.03	1.07	1.05	1.04
Period 2	.92	.97	.93	.96
Total	.80	.80	.76[d]	.83[e]

[a] Main effect least squares means.

[b,c] Means within main effect in the same row with different superscripts differ ($P<.01$).

[d,e] Means within main effect in the same row with different superscripts differ ($P<.05$).

pigs fed diets with plasma protein (Table 3). In contrast, during week 3 when pigs were fed a common corn-soybean meal diet, average daily feed intake was 10% higher ($P<.05$) in pigs fed diets containing soybean meal diets during period 1. This increased intake is consistent with the observed increased gain and may be due to the consumption of soybean meal during period 1, which may increase the subsequent utilization of soybean proteins during week 3. Pigs receiving diets containing soy oil consumed 16% less ($P<.05$) feed than pigs offered diets containing medium-chain triglycerides during week 1. In contrast, pigs offered diets with soy oil during week 2 and period 1 consumed 15 and 16% more ($P<.05$) feed respectively, than pigs receiving diets containing medium-chain triglycerides.. A diet*treatment interaction ($P<.01$) was observed during period 1 and weeks 2 and 4, therefore the simple means are presented (Table 4). During week 2 and period 1, pigs consuming the diets containing soybean meal with added medium-chain triglycerides had lower ($P<.05$) average daily intakes than pigs fed soy oil, whereas feed intake was not affected by fat source in pigs fed the plasma protein complex diet.

Feed efficiency (G:F) during week 1 was 19% greater ($P<.05$) for pigs receiving the diets with plasma protein (Table 5). In contrast, pigs consuming

Table 3. Effect of protein and fat source on feed intake (lb)[a].

	Protein source		Fat source	
Item	AP-820	SBM	MCT	Soy oil
Week 1	.41	.38	.43[b]	.36[c]
Week 2	1.00[b]	.85[c]	.86[b]	.99[c]
Period 1	.70[d]	.62[e]	.61[d]	.71[e]
Week 3	1.35[b]	1.48[c]	1.38	1.46
Week 4	1.85	1.85	1.85	1.85
Week 5	1.98	1.98	1.99	1.98
Period 2	1.73	1.77	1.74	1.76
Total	1.15	1.11	1.13	1.13

[a] Main effect least squares means for average daily feed intake.

[b,c] Means within main effect in the same row with different superscripts differ ($P<.05$).

[d,e] Means within main effect in the same row with different superscripts differ ($P<.01$).

Table 4. Effect of protein and fat source on feed intake (lb)[a].

	Plasma protein		SBM	
Item	MCT	Soy oil	MCT	Soy oil
Week 2[a]	1.00[c]	1.00[c]	.73[d]	.97[b]
Period 1[a]	.69[c]	.72[c]	.54[d]	.69[c]
Week 4[a]	1.78	1.92	1.92	1.76

[a] Least squares means for average daily feed intake.
[b] Diet*fat interaction ($P < .1$), therefore simple effects are presented.
[c,d] Means within rows with different superscripts differ ($P < .05$).

Table 5. Effect of protein and fat source on feed efficiency (Gain:Feed)[a].

	Protein source		Fat source	
Item	AP-820	SBM	MCT	Soy oil
Week 1	.94[b]	.79[c]	.83	.90
Week 2	.85	.90	.86	.89
Period 1	.88	.87	.86	.89
Week 3	.51[b]	.58[c]	.54	.55
Week 4	.55	.53	.53	.54
Week 5	.52	.54	.53	.53
Period 2	.53	.55	.53	.55
Total	.60	.62	.59	.63

[a] Main effect least squares means.
[b,c] Means within main effect in the same row with different superscripts differ ($P < .05$).

the diets with plasma protein during the first period had a 19% lower ($P < .05$) feed efficiency during week 3 when all pigs were fed a common corn-soybean meal diet. During all other periods, no significant difference in feed efficiency due to treatments was observed.

Results of this study are consistant with previous research indicating that plasma proteins will improve performance in early weaning pigs (Sohn et al., 1991). Medium-chain triglycerides improved performance in early weaned pigs in our previous studies when fed up to 6% of the diet (De Rodas and Maxwell, 1990). The lack of consistency in the effect of medium-chain triglycerides may be due to the higher inclusion of medium-chain triglycerides used in this study.

This study suggests that plasma proteins do not improve utilization of either fat source used in this study, sinse performance of pigs fed both fat sources was similar within protein source (no protein source by fat source interaction).

This study suggests that early weaned pigs fed complex prestarter diets containing plasma proteins perform better than pigs fed a complex prestarter diet containing soybean meal. In addition, soy oil was a better fat source than medium-chain triglycerides.

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