EFFECTS OF A HIGH PROTEIN, WHEY PROTEIN CONCENTRATE AND SPRAY-DRIED ANIMAL PLASMA ON GROWTH PERFORMANCE OF WEANLING PIGS[1]

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Summary

A 35-d experiment was conducted to compare the effects of increasing spray-dried animal plasma and a high protein whey concentrate (73% CP) on starter pig performance. Spray-dried animal plasma and whey protein concentrate replaced dried skim milk on an equal lysine basis. Pigs fed increasing spray-dried animal plasma protein had increased ADG and ADFI from d 0 to 7 after weaning, but not for any other period in the study. Increasing whey protein concentrate had no effect on growth performance in relation to the pigs fed dried skim milk.

(Key Words: Starter Pigs, Spray-Dried Animal Plasma, Whey Protein Concentrate.)

Introduction

Several different protein sources have been evaluated by Kansas State University for weanling pigs. These include spray-dried plasma protein, spray-dried blood meal, dried skim milk, and various soy protein concentrates. In this experiment, a special high protein whey protein concentrate was evaluated. This particular whey protein concentrate contains 73% protein and an amino acid profile that is comparable to that of animal plasma. The intent of this experiment was to determine if whey protein concentrate could be an alternative to animal plasma in starter diets.

Procedures

A total of 180 pigs (initially 12.5 lb and 21 d of age) was used in this 35 d growth trial. Pigs were blocked by weight, equalized for sex and ancestry, then allotted randomly to one of six dietary treatments with a total of six pigs/pen and six pens/treatment. Dietary treatments were based on a control diet containing dried skim milk with the treatments containing additional spray-dried animal plasma (2.5 or 5%) or whey protein concentrate (2.7 or 5.4%) substituted for dried skim milk on a lysine basis. Chemical compositions of the whey protein concentrate and spray-dried animal plasma protein are presented in Table 1.

The trial was divided into two phases with the pelleted, experimental diets fed from d 0 to 14 after weaning. All diets were formulated to contain 1.5% lysine, .9% Ca, .8% P. The control diet contained 1.0% spray-dried blood meal, 15.0% dried whey, and 13.4% dried skim milk. Spray-dried animal plasma, added at 2.5 and 5.0%, and lactose replaced skim milk in the control diet on an equal lysine and lactose basis. Experimental whey protein concentrate and lactose replaced dried skim milk, but at levels of 2.7 and 5.4% to provide identical lysine levels. We formulated diets using the calculated amino acid concentrations of high protein, whey protein concentrate provided by the supplier (analyzed values indicated slightly higher lysine concentrations). Additional

[1]The authors thank Formost Farms, USA, Sauk City, WI for providing the whey protein concentrate used in this experiment.

DL-methionine was used to maintain a constant level of methionine in all diets. The amount of crystalline lactose was adjusted so that all diets contained the same amount of total lactose. From d 14 to 35, a common corn-soybean meal diet containing 10% dried whey and 2.5% spray-dried blood meal was fed in a meal form. The common diet was formulated to contain 1.35% lysine, .9% Ca, and .8% P (Table 2).

Pigs were housed in an environmentally controlled nursery in 5 × 5 ft pens. They were provided ad libitum access to feed and water. Average daily gain, ADFI, and F/G were determined by weighing pigs and measuring feed disappearance on d 7, 14, 21, 28, and 35 after weaning.

Results and Discussion

From d 0 to 7 after weaning, ADG and ADFI increased with increasing animal plasma (linear, $P<.01$, Table 3). Feed efficiency was not affected by increasing animal plasma in the diet. Increasing whey protein concentrate did not affect ADG, ADFI, or F/G. From d 0 to 14 after weaning, no differences were observed for pigs fed either of the experimental protein sources.

From d 7 to 14 after weaning, whey protein concentrate resulted in slight improvement in ADG, but when all pigs were fed a common diet (d 14 to 35), the protein source fed from d 0 to 14 after weaning had no effect on ADG or F/G. However, ADFI from d 14 to 35 tended to increase then decrease (quadratic, $P<.10$) with increasing animal plasma fed from d 0 to 14 after weaning.

From d 0 to 35 after weaning, no differences occurred in the growth performance of pigs fed any of the experimental diets.

In conclusion, increasing animal plasma increased ADG and ADFI only from d 0 to 7 after weaning. This suggests that spray-dried animal plasma is an important ingredient in diets fed to pigs immediately after weaning; however, because of cost, animal plasma should be removed from the diet as soon as the responses in feed intake and growth disappear. Pigs fed increasing high protein whey protein concentrate had similar growth performance as those fed the control diet throughout the entire experiment. Based on this one experiment, high protein, whey protein concentrate is an excellent protein source resulting in performance similar to that of pigs fed dried skim milk. However, it cannot replace spray-dried animal plasma for the initial period after weaning.

Table 1. Compositions of High Protein, Whey Protein Concentrate and Spray-Dried Animal Plasma[a]

Item , %	Whey Protein Concentrate	Animal Plasma
Protein	73.18	70.00
Fat	6.00	2.00
Ash	6.50	13.00
Amino Acids		
Arginine	2.32 (1.4)	5.30
Cystine	1.68 (1.9)	2.50
Histidine	1.49 (1.2)	2.80
Isoleucine	4.15 (3.5)	1.96
Leucine	7.43 (7.7)	5.56
Lysine	6.81 (6.3)	6.80
Methionine	1.52 (1.57)	0.53
Phenylalanine	2.67 (2.5)	4.10
Threonine	4.64 (4.8)	4.13
Tryptophan	1.63 (1.7)	1.33
Tyrosine	2.34 (2.3)	3.90
Valine	4.42 (3.6)	4.12

[a]Analyzed values expressed on an as-fed basis; calculated values used in diet formulation are provided in parentheses.

Table 2. Compositions of Diets[a]

Ingredients, %	Control	Spray-Dried Animal Plasma, %		Whey Protein Concentrate, %		Day 14-35[b] Phase II
		2.5	5.0	2.7	5.4	
Corn	37.15	37.69	38.20	37.72	38.31	51.87
Soybean meal	24.17	24.17	24.17	24.17	24.17	26.85
Dried whey	15.00	15.00	15.00	15.00	15.00	10.00
Dried skim milk	13.40	6.70	--	6.70	--	--
Soybean oil	5.00	5.00	5.00	5.00	5.00	4.00
Lactose	--	3.35	6.70	3.08	6.16	--
Monocalcium phosphate	1.36	1.50	1.65	1.65	1.94	1.65
Whey protein concentrate	--	--	--	2.70	5.40	--
Spray-dried animal plasma	--	2.50	5.00	--	--	--
Spray-dried blood meal	1.00	1.00	1.00	1.00	1.00	2.50
Antibiotic[c]	1.00	1.00	1.00	1.00	1.00	1.00
Limestone	.72	.87	1.01	.77	.82	.98
Zinc oxide	.37	.36	.38	.38	.38	.25
Vitamin premix	.25	.25	.25	.25	.25	.25
Salt	.20	.20	.20	.20	.20	.25
Trace mineral premix	.15	.15	.15	.15	.15	.15
L-Lysine HCl	.15	.15	.15	.15	.15	.15
DL-Methionine	.08	.11	.14	.08	.07	.10
Total	100.00	100.00	100.00	100.00	100.00	100.00

[a]Diets were formulated to contain 1.5% lysine, .42% methionine, .9% Ca, and .8% P and fed from d 0 to 14 after weaning. [b]Diet was formulated to contain 1.35% lysine, .38% methionine, .9% Ca, and .8% P and fed to all pigs from d 14 to 35 after weaning. [c]Provided 50 g/ton carbadox.

Table 3. Effects of Increasing Whey Protein Concentrate and Animal Plasma Fed from d 0 to 14 after Weaning on Pig Performance[a]

Item	Control	Spray-Dried Animal Plasma, %		Whey Protein Concentrate, %		CV
		2.5	5.0	2.7	5.4	
D 0 to 7						
ADG, lb[b]	.42	.48	.53	.43	.43	13.5
ADFI, lb[b]	.38	.45	.49	.42	.41	12.0
F/G	.91	.92	.93	.96	.95	9.7
D 7 to 14						
ADG, lb	.80	.79	.70	.80	.84	17.2
ADFI, lb	.84	.79	.79	.80	.84	14.8
F/G	1.05	1.0	1.12	1.0	1.0	13.3
D 0 to 14						
ADG, lb	.61	.64	.61	.62	.64	13.4
ADFI, lb	.61	.62	.64	.61	.62	11.8
F/G	1.01	.97	1.04	.99	.97	8.7
D 14 to 35[c]						
ADG, lb	1.26	1.27	1.27	1.22	1.32	7.0
ADFI, lb[d]	1.89	2.01	1.92	1.91	1.93	4.2
F/G	1.50	1.56	1.52	1.58	1.46	6.7
D 0 to 35						
ADG, lb	1.00	1.03	1.00	.98	1.05	6.2
ADFI, lb	1.38	1.46	1.41	1.39	1.41	4.7
F/G	1.38	1.42	1.40	1.43	1.34	4.7

[a]A total of 180 weanling pigs (initially 12.5 lb and 17 to 21 d of age) with six pigs per pen and six replications per treatment. [b]Linear effect of animal plasma ($P < .01$). [c]Common diet was fed from d 14 to 35 after weaning. [d]Quadratic effect of animal plasma ($P < .10$).