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Effect of Diet and Method of Feeding on Performance of
Pigs Weaned at Three Weeks of Age

Jerry R. Clarkson and Gary L. Allee

Summary

Four trials involving 600 pigs weaned at 15 to 23 days were conducted to evaluate pig performance as affected by added whey and method of feeding during the first week after weaning. Pigs fed 20% dried whole whey gained faster the first two weeks after weaning and during the 35-day trial than did pigs fed a milo-soybean meal diet with no whey. Ten percent dried whole whey did not improve performance over that of the control diet, and 30% dried whey showed no advantage over the 20% whey diet. Pigs fed delactosed whey substituted on a protein basis for 20% dried whole whey performed the same as those fed 20% whole whey. Adding lactose to the basal diet did not improve pig performance.

Pigs fed the 20% whey diet for the first two weeks and the control diet for the last three weeks of the trial performed similar to those fed the 20% whey diet during the entire 35-day trial. By feeding a whey diet for only two weeks, total cost of gain is greatly decreased.

Introduction

The ideal diet and environment for pigs weaned at 14 to 28 days of age remains debatable despite many years of research. Prior to weaning, the sow provides the young pig about 16 equally spaced, highly digestible, high-fat, high-energy, high-lactose meals a day. All pigs within the litter eat at the same time with little fighting over who is to have what dining position. At weaning, we commonly move and mix pigs and offer them a high-carbohydrate, low-fat, low lactose, dry diet from some strange object in one corner of the pen that doesn't look or sound like their mother. As swine producers, we seem to be surprised that a 10 pound pig does not immediately establish a social order, find the feeder, adjust to the drastic change in diet and immediately start eating and gaining weight the first week after weaning.

The present trials were conducted to evaluate the effects of dried whey in the diet on the growth check normally observed after weaning at three weeks. We also wanted to determine if hand-feeding a liquid or dry diet would improve pig performance the first week after weaning.

Procedures

Animals. One hundred and fifty pigs were used in each of four trials. All pigs had access to a pelleted creep diet from two weeks of age until weaning. Pigs were weaned when 15 to 24 days old, with the vast majority 20±2 days old.

Pigs were allotted to treatments by litter and weight. Table 16 gives the range and average age and weight when weaned.

Table 16. Range and Average Age and Weight of Pigs at Weaning

	Age, days		Weight, lbs.	
	Range	Average	Range	Average
Trial I	15-23	19.31	5.5-15.5	10.99
Trial II	18-22	19.81	8-14.5	10.88
Trial III	18-23	20.85	7.6-14.6	11.45
Trial IV	17-24	20.95	7.5-15.0	11.32

Housing: Pigs were reared in an environmentally controlled nursery with woven wire floors over a Y-flush gutter. They were housed in pens (4 ft. x 5 ft.), five pigs per pen. Each pen was equipped with a nipple waterer and a self-feeder. Five-hole stainless steel feeders were used in Trials I, II, and III. A plastic feeder with four feeder holes were used in Trial IV.

Temperature of the nursery was maintained at 90°F for the first week and thereafter reduced 5°F per week.

Diet: All diets were fed in meal form. Table 17 gives percentage composition of the diets used in Trials I, II, and III.

Table 17. Percentage Composition of Diets (Trials, I, II, and III).

Ingredients	Whey %			
	0	10	20	30
Sorghum grain	54.95	48.35	41.35	34.75
Soybean meal (44%)	37.10	34.10	31.50	28.60
Dried whole whey		10.00	20.00	30.00
Corn oil	4.00	4.00	4.00	4.00
Limestone	1.30	1.20	1.00	0.90
Dicalcium phosphate	1.50	1.30	1.20	.90
Trace mineral premix	0.10	0.10	0.10	0.10
Vitamin premix	0.50	0.50	0.50	0.50
Salt	0.30	0.20	0.10	0.00
Antibiotic premix	0.25	0.25	0.25	0.25
<u>Calculated nutrient values:</u>				
Lysine, %	1.21	1.20	1.21	1.21
Crude protein, %	21.21	20.67	20.26	19.74
Calcium, %	.90	.91	.90	.89
Phosphorus, %	.72	.71	.73	.70

General Procedures: Pigs were weaned in the afternoon and immediately moved to the nursery. Feed was made available within one or two hours, and the nipple waterers were blocked open to allow free-flowing water for approximately the first 36 to 48 hours. Thereafter, pigs were visually appraised four times a day, and pigs that appeared not to be consuming water had the nipple blocked open until all pigs had learned to drink.

Pigs were weighed and feed consumption was determined weekly.

All trials lasted five weeks.

Trial I. The first trial was conducted to determine the optimum level of whey in the diet, as well as the effects of hand-feeding a dry or liquid diet for the first week after weaning.

Stainless-steel feeders with five feeding holes were used so all pigs could eat at the same time. Hand-fed pigs were fed four times a day: at 0600, 1000, 1400, and 1800 hours.

The liquid diet, prepared by combining one part of 30% whey diet with one and one-half parts of water, was fed at the rate of 400 g (.88 lb) of dry feed per pen at each feeding. Before the first feeding of each day, the feeders were cleaned and the unconsumed feed of the previous day was discarded. Pigs fed the liquid diet also had access to a self-feeder containing the 30% whey diet in dry form at all times. After the first week, all hand-fed pigs were fed the 30% whey diet from self feeders.

Trial II. This trial was conducted to further compare hand-feeding, in both the dry and liquid form, to ad lib feeding, using these diets: the basal diet (no added whey) and the 20% added whey diet. Each diet was fed ad lib, hand-fed dry, and hand-fed as a liquid.

A four-inch-diameter PVC pipe was used to make a feeder for hand feeding. Hand-feeding procedures were the same as those used in Trial I. At the end of the first week, the hand-fed pigs were placed on a self-feeder containing either the control or the 20% whey diet.

Trial III. This trial compared feeding ad lib to hand-feeding for the first week after weaning and also compared the length of time pigs needed to be fed the 20% whey diet.

Five-hole stainless steel feeders were used for all six treatments in this trial:

1. Control diet fed ad lib.
2. 20% whey diet fed ad lib.
3. 20% whey diet hand-fed (dry) for the first week; then control diet ad lib.
4. 20% whey diet hand-fed (liquid) for the first week; then control diet ad lib.
5. 20% whey diet hand-fed (liquid) for one week, followed by one week of ad lib feeding of 20% whey diet, then control diet for three weeks.

6. 20% whey diet hand-fed (dry) for one week, followed by one week of feeding the 20% diet ad lib, then control diet for three weeks.

Trial IV. This trial compared whole whey to delactosed whey and attempted to determine the effect of lactose level on pig performance. Four-hole plastic feeders were used for all treatments, with all diets fed ad lib in dry form:

1. Control diet.
2. 20% dried whole whey.
3. 20% delactosed whey.
4. 20% delactosed whey plus lactose to the level present in diet 2.
5. Delactosed whey added to supply the same milk protein level as in diet 2.
6. Control diet plus lactose to the lactose level of diet 2.

Results

Trial I. The effects of level of spray-dried whole whey in the diet on pig performance are shown in Table 18. Pigs fed 10% dried whey had similar gains and feed efficiencies as did pigs fed the control diet. Twenty percent whole whey appeared to be the optimal level of whole whey. Pigs fed 30% whey performed similar to those fed 20% whey. Compared with pigs fed the control diet, those fed a diet with 20% added whey significantly ($P < .05$) improved: gain the first week (.59 vs 1.32 lb), gain the second week (2.95 vs 3.74 lbs), gain during the first two weeks after weaning (3.54 vs 5.06 lb) and during the entire 35-day trial (24.29 vs 27.13 lbs).

Table 18. Effect of Level of Whey and Method of Feeding on Performance of Pigs Weaned at 15-23 Days of Age (Trial I)^a.

Level of whey (%)	0	10	20	30	30	30
Feeding method	ad lib	ad lib	ad lib	ad lib	hand-fed dry	hand-fed liquid
<u>Week 1</u>						
Feed intake, lbs.	2.07	2.60	2.64	2.66	2.66	4.81
Gain, lbs.	.59	.70	1.32	1.21	1.85	2.29
Feed:gain	3.51	3.71	2.00	2.20	1.44	2.10
<u>Week 2</u>						
Feed intake, lbs.	4.95	4.62	5.30	5.12	6.27	6.25
Gain, lbs.	2.95	3.08	3.74	3.74	4.81	4.31
Feed:gain	1.68	1.50	1.42	1.37	1.30	1.45
<u>Week 1 & 2</u>						
Feed intake, lbs.	7.00	6.89	7.94	7.79	8.91	11.07
Gain, lbs.	3.54	3.78	5.06	4.95	6.67	6.60
Feed:gain	1.98	1.82	1.57	1.57	1.33	1.68
<u>Entire trial</u> (5 weeks)						
Feed intake, lbs.	42.35	43.41	46.18	47.74	49.06	53.37
Gain, lbs.	24.29	24.97	27.13	28.01	29.99	30.54
Feed:gain	1.74	1.74	1.70	1.70	1.64	1.75

^aFive pigs per pen with five pens per treatment.

Level of whey in the diet did not affect feed efficiency during the 35-day trial.

Hand-feeding significantly increased feed intake and weight gain during the first week after weaning. Hand-feeding the diet as a liquid increased feed consumption more than did hand-feeding the diet in dry form. Pigs that were hand-fed during week one gained more weight during the second week than pigs did fed ad libitum.

Trial II. Hand-feeding for the first week appeared to increase feed intake the first week after weaning (Table 19). However, gain was not improved by hand-feeding, and feed:gain was increased, indicating hand-fed pigs wasted a considerable quantity of feed offered.

Table 19. Effect of Feeding 20% Added Whey and Method of Feeding
Performance of Pigs Weaned at 18-22 Days of Age (Trial II)^a

Level of whey (%) Feeding method	0 ad lib	0 hand-fed (dry)	0 hand-fed (liquid)	20 ad lib	20 hand-fed (dry)	20 hand-fed (liquid)
<u>Week 1</u>						
Feed intake, lbs.	2.24	5.13	3.19	2.22	5.70	3.81
Gain, lbs.	.57	.77	.42	1.01	.99	.92
Feed:gain	3.93	6.66	7.59	2.20	5.76	4.14
<u>Week 2</u>						
Feed intake, lbs.	4.31	4.99	4.29	5.26	4.73	5.15
Gain, lbs.	2.11	2.88	2.57	3.48	3.23	3.26
Feed:gain	2.04	1.73	1.67	1.51	1.46	1.58
<u>Week 1 & 2</u>						
Feed intake, lbs.	6.55	10.12	7.48	7.48	10.43	8.98
Gain, lbs.	2.68	3.63	2.99	4.51	4.20	4.18
Feed:gain	2.44	2.79	2.50	1.66	2.48	2.14
<u>Entire trial (5 weeks)</u>						
Feed intake, lbs.	38.59	41.91	38.39	44.31	47.94	45.01
Gain, lbs.	22.55	26.09	23.96	28.58	27.32	27.24
Feed:gain	1.71	1.61	1.50	1.55	1.75	1.65

^aFive pigs per pen with five pens per treatment.

Pigs fed 20% dried whole whey gained significantly ($P < .05$) more for the first week and the second week after weaning than did pigs fed the control diet with no added whey. Pigs fed the 20% dried whey diet gained more weight during the 35-day trial than pigs fed the control diet (24.2 vs 27.71 lbs).

Trial III. Hand-feeding the first week after weaning did not affect feed consumption or gain (Table 20).

Table 20. Effect of Adding 20% Whey, Method of Feeding, and Duration of Whey Feeding on Performance of Pigs Weaned at 18-23 Days of Age (Trial III)^a

<u>Week 1</u>						
Level of whey(%)	0	20	20	20	20	20
Feeding method	ad lib	ad lib	hand-fed (dry)	hand-fed (dry)	hand-fed (liquid)	hand-fed (liquid)
<u>Week 2</u>						
Level of whey	0	20	20	0	0	20
Feeding method	ad lib	ad lib	ad lib	ad lib	ad lib	ad lib
<u>Week 3-5</u>						
Level of whey	0	20	0	0	0	0
<u>Week 1</u>						
Feed intake, lbs.	2.53	2.84	2.60	2.53	2.84	2.70
Gain, lbs.	.66	1.32	1.14	1.14	1.01	.81
Feed:gain	3.83	2.15	2.28	2.22	2.81	3.33
<u>Week 2</u>						
Feed intake, lbs.	5.06	5.46	5.32	4.95	5.79	5.15
Gain, lbs.	2.40	3.06	2.86	1.98	2.22	2.44
Feed:gain	2.11	1.78	1.86	2.50	2.61	2.11
<u>Week 1 & 2</u>						
Feed intake, lbs.	7.59	8.29	7.92	7.50	8.62	7.83
Gain, lbs.	3.06	4.38	4.03	3.21	3.23	3.28
Feed:gain	2.48	1.89	1.96	2.40	2.67	2.39
<u>Entire trial</u> (5 weeks)						
Feed intake, lbs.	40.70	45.06	46.07	40.61	44.35	42.57
Gain, lbs.	24.09	25.85	26.47	23.06	25.56	25.19
Feed:gain	1.69	1.74	1.74	1.76	1.74	1.69

^aFive pigs per pen with five pens per treatment.

Pigs fed the 20% whey diet gained more during the first and second week after weaning than pigs fed the control diet. Pigs fed the 20% whey diet for two weeks after weaning had a greater feed intake ($P<.05$) and greater total gain ($P<.05$) than pigs fed the control diet or those fed the 20% whey diet for only one week after weaning. There was no difference in total gain between pigs fed the 20% whey diet for two weeks followed by the control diet and pigs fed the 20% whey diet the entire trial.

Trial IV. Pigs fed diets with whey added gained significantly ($P<.05$) more week one and week two (Table 21), and feed efficiency was improved ($P<.05$) during week one. Whole whey and delactosed whey resulted in similar

pig performance. Adding lactose to the delactosed whey did not improve pig performance. Pigs fed 10.9% delactosed whey (same milk protein level as 20% whole whey) resulted in similar pig performance as feeding 20% whole whey. Adding lactose to the control diet did not improve rate of gain or feed efficiency.

Table 21. Effect of Whole Whey, Delactosed Whey, and Lactose on Performance of Pigs Weaned at 17-24 Days of Age (Trial IV)^a

Treatments	Control	20% Whole whey	20% Delactosed whey	20% Delactosed whey	10.9% Delactosed & lactose	Control +
						lactose
<u>Week 1</u>						
Feed intake, lbs.	2.73	2.99	3.85	3.85	3.17	2.49
Gain, lbs.	.52	1.05	1.01	1.21	1.21	.66
Feed:gain	5.25	2.85	3.81	3.18	2.62	3.77
<u>Week 2</u>						
Feed intake, lbs.	4.51	4.80	5.48	4.95	5.15	4.49
Gain, lbs.	2.38	2.84	2.75	2.88	2.88	2.20
Feed:gain	1.89	1.69	1.99	1.72	1.79	2.04
<u>Week 1 & 2</u>						
Feed intake, lbs.	7.22	7.81	9.33	8.80	8.29	6.95
Gain, lbs.	3.08	4.27	4.47	4.99	4.60	2.99
Feed:gain	2.34	1.83	2.09	1.76	1.80	2.32
<u>Entire trial</u> (5 weeks)						
Feed intake, lbs.	38.04	43.54	45.56	43.32	43.34	38.13
Gain, lbs.	21.85	22.97	24.75	25.32	25.59	19.54
Feed:gain	1.74	1.89	1.84	1.71	1.69	1.95

^aFive pigs per pen with five pens per treatment.

Discussion

The digestive system of the pig changes dramatically during the first eight weeks of life. Lactose, the major carbohydrate in milk, is readily digested by the pig at birth. The pig's ability to digest carbohydrates and protein from cereal grains increases with age but may be marginal for pigs weaned when 17 to 21 days of age.

The results of these studies demonstrate that adding 20% dried whey to the diet of pigs weaned when 15 to 23 days of age increases feed consumption and weight gain the first two weeks after weaning. The response in weight gain could be a result of the milk protein supply by the whey or the highly digestible lactose in whey. The results of Trial IV suggest that the beneficial response from whey was due mainly to the milk protein because delactosed whey and whole whey gave the same response. Additionally, adding lactose to the delactosed whey did not improve pig performance, nor did adding lactose to the milo-soybean meal diet.

Hand-feeding the first week after weaning improved pig performance in Trial I, but that response was not consistent in subsequent trials. Because all pigs were housed in the same nursery, hand-feeding might have stimulated the pigs fed ad lib to consume additional feed during the increased activity of the hand-fed pigs.

The poor feed conversion of the hand-fed pigs suggests that feed wastage can be a problem when hand-feeding. We observed considerable feed wastage by the pigs that were hand-fed in all trials.

The results of Trial III suggest that pigs fed the 20% whey diet for two weeks and then fed the control diet for three weeks had the same gain and feed conversion as pigs fed the 20% whey diet for the entire five weeks of the study. Since the 20% whey diet is more expensive than the control diet, feeding the 20% whey diet for only the first two weeks after weaning can greatly reduce the cost of gain.

In four trials involving 600 pigs, mortality was zero. That demonstrates that with an excellent environment and diet, pigs can be weaned at 17 to 21 days of age with excellent performance.