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Abstract

A total of 943 newly weaned (18 to 30 days of age) pigs were used in five trials to evaluate the addition of lysine and dried whey in starter diets. The results of these studies show that the lysine requirement is 1.2 to 1.3% during the nursery phase (up to approximately 50 lbs). When lysine levels are greater than 1.3% with added L-lysine monohydrochloride, a reduction in performance will be evident (P<.05). Rolled dried whey appears to be inferior (P<.10) to spray dried whey in starter pig diets.; Swine Day, Manhattan, KS, November 11, 1982

Keywords

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Lysine and Dried Whey Additions in Starter Pig Diets

D.S. Pollmann, G.A. Allee and R.H. Hines

Summary

A total of 943 newly weaned (18 to 30 days of age) pigs were used in five trials to evaluate the addition of lysine and dried whey in starter diets. The results of these studies show that the lysine requirement is 1.2 to 1.3% during the nursery phase (up to approximately 50 lbs). When lysine levels are greater than 1.3% with added L-lysine monohydrochloride, a reduction in performance will be evident ($P<.05$). Rolled dried whey appears to be inferior ($P<.10$) to spray dried whey in starter pig diets.

Introduction

In last year's Swine Day Report (1981) the value of dried whey in starter pig diets was discussed. It was concluded that a 20% dried whey diet improved the performance of pigs weaned at approximately 3 weeks of age. It also was suggested that the dried whey diets need to be fed only for 2 weeks after weaning. It was postulated that the mode of action of the whey was a difference in amino acid availability (protein quality), particularly lysine. Therefore, a series of experiments were conducted to evaluate the effect of various lysine levels and source of dried whey on performance of starter pigs.

Experimental Procedures

Pigs were weaned and moved into an environmentally controlled nursery with woven wire floors over a Y-flush gutter. Pigs were housed in pens (4 ft x 5 ft) with a nipple waterer and self feeder. Temperature of the nursery was maintained at approximately 90°F.

Trial 1. This trial was conducted to determine the effect of various levels of lysine in starter pig diets. The diets (Table 1) were corn-soybean meal with 20% spray dried whey. The basal diet contained 17.4% crude protein and .95% lysine. The lysine level was increased at .1% increments to 1.35% lysine using L-lysine monohydrochloride (HCl).

Since earlier research has shown that the addition of dried whey in the diet was necessary only the first two weeks after weaning, it was postulated that a lower lysine level may also be possible after two weeks. Therefore, an additional dietary treatment of 20% dried whey plus 1.25% lysine was fed the first two weeks after weaning and then the pigs were offered a .95% lysine diet without the dried whey. A total of 210 pigs (7 pigs/pen; 5 pens/treatment) with an average initial weight of 16.6 lbs and an age range of 21 to 33 days were used in the six-week trial.

Trial 2. A total of 175 pigs (7 pigs/pen; 5 pens/treatment) average initial weight of 13.5 lbs with an age range of 21 to 32 days were used. All pigs were fed a 20% spray dried whey diet with 1.25% lysine the first two weeks after weaning. The objective of this study was to evaluate the level of lysine and the value of dried whey in the starter pig diet in the last six weeks in the nursery. The diets (Table 2) are milo-soybean meal formulated to have 18.2% crude protein, .8% calcium and .7% phosphorus. One treatment contained 20% dried whey plus 1.25% lysine and the other four diets contained no whey with varying levels of lysine from .95 to 1.25%. The whey was substituted for the milo portion of the diet.

Trial 3. This trial was conducted to evaluate the value of 20% whey (spray dried) diet with varying levels of lysine from 1.2 to 1.4%. Diets (Table 3) were corn-soybean meal with three treatments containing no whey and three with 20% dried whey. Lysine levels were increased at .1% increments using L-lysine HCl. In this study, 210 pigs (7 pigs/pen; 5 pens/treatment) averaging 12.1 lbs were randomly allotted to the treatments in the two-week trial.

Trial 4. Trial 4 was conducted to evaluate the effect of the source of dried whey (spray dried vs rolled dried) with varying levels of lysine. Corn-soybean meal diet contained 20% rolled dried[1] or spray dried whey. Both diets (Table 4) were formulated to have 16.5% protein. To evaluate protein availability of the two whey sources, lysine levels were increased in .15% increments to 1.2% using L-lysine HCl. In the six-week trial, 168 pigs (7 pigs/pen; 4 pens/treatment) with average initial weight of 11.4 lbs and an age range of 17 to 26 days were allotted randomly to the six dietary treatments.

Trial 5. This trial was conducted to evaluate the effect of the added whey (rolled dried) with varying levels of lysine. The same diet composition used in Trial 4 was compared to diets containing no whey. Corn-soybean meal diet was formulated at 17.5% protein. Lysine levels (.9, 1.05, and 1.20%) were similar between the diets containing the 20% whey and without the whey. Lysine levels were increased as previously described using L-lysine HCL. In this study, 180 pigs (6 pigs/pen; 5 pens/treatment) with average initial weights of 12.3 lbs and an age range of 21 to 31 days were observed in the six-week trial.

Results and Discussion

Trial 1. In this trial, by increasing the lysine level to 1.25%, an improvement in average daily gain and feed efficiency was observed (Table 5). Gains were higher ($P<.05$) at each two-week weighing interval for the 1.25% lysine treatment. The National Research Council (1979) recommended that the lysine level of .95% for newly weaned pigs. However, these results suggests lysine levels be considerably higher.

When the pigs received lysine levels of 1.35%, the gain was reduced (quadratic effect, $P<.05$). Since synthetic lysine was used to increase the lysine level in the diets, the excessive levels of lysine tended to suppress performance.

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[1]Donated by Dried Whey, Inc., Monticello, IA.

Since the second objective of this trial was to evaluate what level or levels of lysine should be used in starter pig diets, the two lysine sequence (1.25 and .95%) was inferior (P<.05) to the diet containing 1.25% lysine throughout the six-week trial. Therefore, it can be concluded that the dried whey is beneficial primarily the first two weeks after weaning and if the lysine level is dropped to .95% a reduction in performance will be observed.

Trial 2. During the first two weeks of the study when the pigs were consuming diets containing 1.25% lysine and 20% dried whey, there were no differences in pig performance. When pigs were no longer consuming the 20% whey diet with varying levels of lysine, pigs on 1.25% lysine diet performed better (P<.05) than those on the lower lysine levels, as observed in Trial 1 (Table 6). It is interesting to note that pigs on the 1.25% lysine diet without the dried whey performed slightly better than pigs on the whey diet during the third and fourth week in the nursery. There was no advantage to the 20% whey diet after two weeks confirming earlier observations. Although during the fifth and sixth week in the nursery, pigs on the lower lysine levels tended to compensate for the slight reduction in gain. During the seventh and eighth week, the pigs receiving the 20% whey diet had lower (P<.05) average daily gain than those without the whey. This, perhaps, is due to feed accessibility, since whey tends to increase the amount of bridging, making feed less available to the pigs.

There were no differences among the treatments on the overall performance. In many on-farm situations, the starter diet would have been terminated at the end of six weeks, since pigs would have been moved out of the nursery. Therefore, if swine producers are able to keep pigs in the nursery for approximately eight weeks after weaning, the lower level of lysine would appear to be adequate. Although, in most swine operations when pigs approach 40 to 50 lbs, the protein level is reduced in the diet (16% protein and approximately .75% lysine).

Trial 3. By adding the 20% dried whey to starter pig diets, an increase of 5.6% in average daily gain was observed (Table 7). Average daily gain of pigs consuming the 1.3% lysine diet was superior (P<.05) to the 1.2% lysine level. When the lysine level was increased to 1.4% a reduction in performance was observed. These results are similar to earlier trials.

Trial 4. Although gain, feed intake and feed efficiency were not different (P<.05), a tendency was observed for the dried rolled whey to be slightly inferior to the spray dried whey (Table 8). The average daily gain of the pigs consuming the rolled dried whey was slightly reduced (P<.15) during the last four weeks of the trial. Pigs tended to eat less (P<.10) rolled dried whey diets during the last two weeks of the trial. Pigs tended to be less efficient (P<.10) on the rolled dried whey compared to the spray dried whey. Since the whey sources came from different locations, it is not totally conclusive that the drying process of the whey reduced protein quality.

The results of this trial agree with the earlier observations on the influence of the lysine level on performance. Pigs perform better (P<.05) on 1.2% lysine than the lower two levels (Table 9). Therefore, in this study the lysine levels did not perform differently with the different sources of whey (Table 10).

Trial 5. The results of this trial concur with conclusions from the previous studies suggesting that 1.2% lysine diet will increase (P<.05) performance of newly weaned pigs (Table 11). Rolled dried whey addition to the diet did not improve gain (Table 12). During the fifth and sixth week of the trial, pigs on the 20% dried rolled whey diet consumed more (P<.05) feed than those on diets without the whey (2.13 vs 2.34 lbs/day). Since gain was not different, feed efficiency tended to be worse for the whey-added treatments (P<.05). This is contrary to earlier observations but may be related to the source of dried whey.

A lysine by whey interaction (P<.05) was observed on feed:gain ratio, suggesting that the lysine level in whey may be less available (Table 13).

Table 1. Diet Compositions in Trial 1

	Treatments	
	+ Whey	No Whey
Corn, ground	54.00	68.10
Soybean meal, 44%	22.50	27.50
Dried whey, spray	20.00	-.-
Dicalcium phosphate	1.70	2.05
Limestone	.75	1.00
Salt	.20	.50
Trace mineral mix	.10	.10
Vitamin premix	.50	.50
ASP-250	.25	.25
	100.00	100.00
Calculated composition:		
Protein, %	17.2	18.3
Lysine, %	.95	.95
Calcium, %	.90	.90
Phosphorus, %	.80	.80

Table 2. Diet Compositions in Trial 2

Ingredients	Treatments A	B	C	D	E
Milo, ground	48.70	68.90	68.77	68.65	68.52
Soybean meal, 44%	27.50	27.50	27.50	27.50	27.50
Dried whey, spray	20.00	-	-	-	-
Dicalcium phosphate	1.55	1.55	1.55	1.55	1.55
Limestone	1.10	1.10	1.10	1.10	1.10
Salt	.10	.10	.10	.10	.10
Trace mineral mix	.10	.10	.10	.10	.10
Vitamin premix	.50	.50	.50	.50	.50
ASP-250	.25	.25	.25	.25	.25
L-lysine HCl	.20	-	.13	.25	.38
	100.00	100.00	100.00	100.00	100.00
Calculated composition:					
Protein, %	19.2	18.2	18.2	18.2	18.2
Calcium, %	.99	.80	.80	.80	.80
Phosphorus, %	.79	.70	.70	.70	.70
Lysine, %	1.25	.95	1.05	1.15	1.25

Table 3. Diet Compositions in Trial 3

	Treatments No Whey	+20% Whey
Corn	56.85	44.44
Soybean meal, 44%	37.00	30.50
Dried whey, spray	-	20.00
Dicalcium phosphate	1.30	1.15
Limestone	1.50	.96
Salt	.50	.10
Trace mineral mix	.10	.10
Vitamin premix	.50	.50
ASP-250	.25	.25
Corn oil	2.00	2.00
	100.00	100.00
Calculated composition:		
Protein, %	21.4	20.6
Lysine, %	1.20	1.20

Table 4. Diet Composition in Trials 4 and 5

	Treatments	
	+ Whey	No Whey
Corn, ground	56.00	70.25
Soybean meal, 44%	20.50	25.50
Dried whey	20.00	-
Dicalcium phosphate	1.75	2.10
Limestone	.70	.90
Salt	.20	.40
Trace mineral mix	.10	.10
Vitamin premix	.50	.50
ASP-250	.25	.25
	100.00	100.00
Calculated composition:		
Protein, %	16.5	17.5
Lysine, %	.90	.90
Calcium, %	.88	.88
Phosphorus, %	.80	.80

Table 5. Effect of Level of Lysine in 20% Whey Starter Pig Diets (Trial 1)[a]

	Lysine level, %					
	.95	1.05	1.15	1.25	1.35	1.25/.95[b]
ADG, lbs						
Week 0-2	.47	.47	.51	.56	.52	.56
Week 3-4	.96	1.03	1.01	1.08	1.03	.95
Week 5-6[cd]	.97	1.03	1.08	1.14	1.01	.99
Overall[cd]	.80	.85	.87	.93	.86	.85
Avg. daily feed intake, lbs						
Week 0-2	.73	.77	.77	.82	.78	.79
Week 3-4	1.91	1.76	1.92	1.84	1.93	1.75
Week 5-6	2.43	2.34	2.43	2.51	2.44	2.26
Overall	1.69	1.63	1.71	1.72	1.72	1.60
Feed/gain						
Week 0-2	1.57	1.75	1.52	1.48	1.49	1.41
Week 3-4	1.99	1.73	1.91	1.72	1.88	1.85
Week 5-6[d]	2.51	2.28	2.24	2.19	2.43	2.28
Overall[cd]	2.10	1.93	1.96	1.86	2.01	1.88

[a]Basal diet, corn-SBM + 20% whey at 17.4% protein; Avg. initial wt, 16.6 lbs; Age range, 21 to 33 days; 7 pigs/pen; 5 pens/treatment; 6-wk trial.
[b]1.25% lysine week 1 & 2 then week 3 to 6 on .95% lysine without whey.
[c]Linear effect (P<.05).
[d]Quadratic effect (P<.05).

Table 6. Effect of Level of Lysine and Dried Whey in Starter Pig Diets (Trial 2)[a]

	Treatment				
% whey	20	0	0	0	0
Time in nursery % lysine	1.25	.95	1.05	1.15	1.25
3-4 weeks:					
Avg. daily gain, lbs[bc]	.96	.83	.87	.91	1.07
Feed/gain[c]	1.80	2.02	2.01	1.87	1.97
5-6 weeks:					
Avg. daily gain, lbs	1.25	1.14	1.25	1.23	1.20
Feed/gain	2.08	2.08	1.98	1.98	2.10
7-8 weeks:					
Avg. daily gain, lbs[c]	1.18	1.36	1.28	1.28	1.28
Feed/gain	2.41	2.31	2.40	2.41	2.37

[a]All pigs were fed 20% dried whey + 1.25% lysine first two weeks after weaning; 7 pigs/pen; 5 pens/treatment.
[b]Lysine linear effect (P<.05).
[c]Treatment effect (P<.05).

Table 7. Effect of Varying Levels of Lysine in Starter Diets With and Without Dried Whey (Trial 3)[a]

	0% Whey			20% Whey		
Lysine level, %	1.2	1.3	1.4	1.2	1.3	1.4
Avg. daily gain, lbs						
First week	.20	.25	.24	.24	.24	.26
Second week	.53	.50	.49	.47	.59	.52
Overall	.36	.38	.35	.36	.40	.39
Feed/gain						
First week	1.74	1.58	1.90	1.58	1.76	1.40
Second week[bc]	1.48	1.32	1.52	1.52	1.32	1.50
Overall[de] 1.55	1.37		1.59	1.54	1.42	1.51
Avg. daily feed intake, lbs						
First week	.35	.39	.37	.35	.38	.41
Second week	.74	.65	.73	.72	.73	.76
Overall	.56	.52	.55	.54	.55	.58

[a]2-week trial; 7 pigs/pen; 5 pens/treatment; corn-SBM diet; Avg. initial wt., 12.1 lbs.
[b]Lysine effect (P<.05).
[c]Quadratic lysine effect (P<.01).
[d]Lysine effect (P<.08).
[e]Quadratic lysine (P<.03).

Table 8. Comparison of Spray Dried vs Dried Rolled Whey in Starter Pig Diet (Trial 4)[a]

	Source of whey	
	Spray dried	Rolled dried
Avg. daily gain, lbs		
Week 0-2[b]	.37	.37
Week 3-4[b]	.74	.70
Week 5-6[b]	1.06	1.02
Overall	.73	.70
Avg. daily feed intake, lbs		
Week 0-2	.53	.57
Week 3-4	1.39	1.36
Week 5-6[c]	2.17	2.08
Overall	1.36	1.34
Feed/gain		
Week 0-2[c]	1.47	1.54
Week 3-4[c]	1.88	1.96
Week 5-6	2.05	2.04
Overall[d]	1.89	1.93

[a]7 pigs/pen; 12 pens/treatment.
[b]Source difference (P<.15).
[c]Source difference (P<.10).

Table 9. Effect of Level of Lysine in Starter Pig Diets (Trial 4)[a]

	Lysine level, %		
	.90	1.05	1.20
Avg. daily gain, lbs			
Week 0-2[b]	.34	.36	.41
Week 3-4[b]	.66	.73	.78
Week 5-6[b]	.97	1.02	1.13
Overall[b]	.65	.70	.77
Avg. daily feed intake, lbs			
Week 0-2	.54	.54	.57
Week 3-4	1.33	1.39	1.42
Week 5-6	2.10	2.10	2.16
Overall	1.32	1.34	1.38
Feed/gain			
Week 0-2[b]	1.61	1.52	1.38
Week 3-4[b]	2.03	1.91	1.83
Week 5-6[b]	2.16	2.06	1.91
Overall	2.02	1.91	1.79

[a]Corn-SBM diet with 20% dried whey; Protein level, 16.5%; Lysine levels were increased with synthetic lysine; 8 pens/treatment.
[b]Lysine linear effect (P<.05).

Table 10. Effect of Source of Dried Whey and Lysine Level in Starter Pig Diets (Trial 4)[a]

Source of whey	Spray dried			Rolled dried		
Lysine level, %	.9	1.05	1.20	.9	1.05	1.20
Avg. daily gain, lbs						
Week 0-2[b]	.33	.35	.42	.35	.36	.41
Week 3-4[b]	.66	.77	.80	.65	.69	.75
Week 5-6[b]	.98	1.05	1.16	.96	.99	1.11
Overall[b]	.66	.72	.79	.65	.69	.75
Avg. daily feed intake, lbs						
Week 0-2	.51	.52	.56	.58	.56	.57
Week 3-4	1.35	1.42	1.41	1.30	1.36	1.43
Week 5-6	2.13	2.18	2.20	2.08	2.02	2.13
Overall	1.33	1.37	1.39	1.32	1.31	1.38
Feed/gain						
Week 0-2[b]	1.54	1.51	1.35	1.68	1.53	1.41
Week 3-4[b]	2.05	1.84	1.76	2.01	1.99	1.90
Week 5-6[b]	2.17	2.08	1.89	2.16	2.04	1.93
Overall	2.01	1.90	1.75	2.03	1.92	1.84

[a]Avg. initial wt., 11.4 lbs; Age range, 17 to 25 days;6-week trial, 7 pigs/pen; 4 pens/treatment.
[b]Lysine linear effect (P<.05).

Table 11. Effect of Lysine Level in Starter Pig Diets (Trial 5)[a]

	Lysine level, %		
	.9	1.05	1.20
Avg. daily gain, lbs			
Week 0-2[b]	.40	.40	.42
Week 3-4[b]	.83	.84	.93
Week 5-6[b]	1.07	1.12	1.20
Overall[b]	.77	.79	.85
Avg. daily feed intake			
Week 0-2	.61	.60	.59
Week 3-4	1.61	1.60	1.69
Week 5-6	2.28	2.24	2.18
Overall	1.50	1.48	1.62
Feed/gain			
Week 0-2[b]	1.52	1.59	1.43
Week 3-4[b]	1.95	1.91	1.83
Week 5-6[b]	2.14	2.00	1.90
Overall	1.96	1.88	1.79

[a]Avg. initial wt., 12.3 lbs; 6-week trial.
[b]Linear lysine effect (P<.05).

Table 12. Effect of Dried Rolled Whey in Starter Pig Diets (Trial 5)[a]

	Level of whey, %	
	0	20
Avg. daily gain, lb		
Week 0-2	.41	.40
Week 3-4	.87	.86
Week 5-6	1.14	1.12
Overall	.81	.49
Avg. daily feed intake, lb		
Week 0-2	.58	.61
Week 3-4[b]	1.62	1.64
Week 5-6[b]	2.13	2.34
Overall	1.53	1.53
Feed/gain		
Week 0-2	1.45	1.58
Week 3-4[b]	1.86	1.93
Week 5-6[b]	1.94	2.09
Overall	1.82	1.94

[a]Avg. initial wt., 12.3 lbs; 6-week-trial.
[b]P<.05

Table 13. Effect of Varying Lysine Level in Starter Diets Containing Dried Rolled Whey (Trial 5)[a]

	Whey level					
	0			20		
Lysine level, %	.90	1.05	1.20	.90	1.05	1.20
Avg. daily gain, lbs						
Week 0-2[b]	.40	.41	.42	.40	.38	.42
Week 3-4[b]	.86	.83	.92	.79	.86	.93
Week 5-6[b]	1.10	1.10	1.21	1.04	1.14	1.19
Overall[b]	.79	.78	.85	.74	.79	.84
Avg. daily feed intake, lbs						
Week 0-2	.57	.59	.59	.65	.61	.59
Week 3-4	1.54	1.59	1.72	1.67	1.60	1.65
Week 5-6[c]	2.16	2.19	2.04	2.40	2.29	2.31
Overall	1.42	1.46	1.72	1.57	1.50	1.52
Feed/gain						
Week 0-2[b]	1.43	1.44	1.47	1.60	1.73	1.40
Week 3-4[bd]	1.77	1.93	1.88	2.12	1.88	1.77
Week 5-6[bcd]	1.96	1.99	1.85	2.31	2.00	1.95
Overall	1.80	1.86	1.79	2.12	1.90	1.80

[a]Avg. initial wt., 12.3 lbs.; age range 21 to 31 days; 6-week trial.
[b]Lysine level effect (P<.05).
[c]Whey effect (P<.05).