COMPARISON OF EDIBLE GRADE WHEY, GRANULAR WHEY, AND DAIRYLAC 80® AS LACTOSE SOURCES FOR NURSERY PIG DIETS

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Summary

Two hundred ten weanling pigs (initially 12.4 lb and 18 ± 2 d of age) were used in a 14-d growth assay to determine the influence of various lactose sources and levels on nursery pig performance. From d 0 to 14, the mean ADG and ADFI of pigs fed additional lactose, regardless of source, was greater and tended to be greater compared to those fed no supplemental lactose. Pigs fed edible grade whey had increased ADFI and tended to have increased ADG as lactose increased from 9 to 18%. When Dairylac 80® or granular whey was included in the diet, ADG and ADFI were increased over the control, but no further improvement above the 9% level was observed. However, pigs fed 9% granular whey and Dairylac 80 had similar performance to those fed 18% edible grade whey. For pigs fed Dairylac 80, F/G also improved linearly as lactose increased to 18% in the diet. No differences in growth performance were observed among lactose sources used in this study.

(Key Words: Pig, Lactose, Whey.)

Introduction

Research with nursery pigs has demonstrated linear improvements in growth performance with increasing lactose level of the diet. The diets fed to pigs immediately after weaning routinely contain 18 to 25% lactose with edible-grade, spray-dried whey used as the standard lactose source for these diets. However, spray-dried whey is often limited in availability and more expensive than alternative lactose sources. In field experiments, Dairylac 80 and granular whey have provided similar performance when replacing edible-grade whey in the phase 2 diet. Further research is needed to determine the ability of these lactose sources to replace a high quality, edible-grade whey in the diet fed immediately after weaning.

Procedures

A total of 210 pigs (BW of 12.4 lb and 18 ± 2 d of age) were used in a 14-d growth assay. Pigs were blocked by weight and allotted to one of seven dietary treatments. The seven experimental treatments were a negative control without lactose and a 2 x 3 factorial consisting of two lactose levels (9 and 18%) and three lactose sources (edible-grade whey, Land O'Lakes; granular whey, International Ingredients Corp.; and Dairylac 80, International Ingredients Corp.). There were five pigs/pen and six pens/treatment. Pigs were housed in the Kansas State University Segregated Early Weaning Facility. Each pen was 4 × 4 ft and contained one self-feeder and one nipple waterer to provide ad libitum access to feed and water. Initial temperature was 90°F for the first 5 d and was lowered approximately 3°F each week thereafter.

All diets were fed in pelleted form and formulated to contain 1.60% lysine (Table 1). The negative control diet contained 3% animal plasma and 2% select menhaden fish meal. Either edible-grade or granular dried whey (12.5 and 25%) replaced corn and soybean meal in the diet. Diets containing

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Dairylac 80 were formulated to replace the lactose provided in the dried whey diets. In addition, select menhaden fish meal was used to replace the amino acids provided by dried whey. The level of fish meal increased as Dairylac 80 increased in order to keep the soybean meal levels consistent with the diets containing dried whey. Dried whey was considered to contain 72% lactose and Dairylac 80 was considered to contain 80% lactose for diet formulation.

Lactose sources and feed samples were collected for determination of percentage lactose, protein, and ash. In addition, a Pellet Durability Index was conducted on each treatment diet for determination of pellet quality. Average daily gain, ADFI, and F/G were determined by weighing pigs and measuring feed disappearance on d 7 and 14 postweaning.

Data were analyzed as a randomized complete block design with pen as the experimental unit. Pigs were blocked based on weaning weight, and analysis of variance was performed using the GLM procedure of SAS.

Results and Discussion

Chemical analysis of lactose sources revealed similar compositions for each product as to their labeled claims of lactose and protein percentages (Table 2). Also, ash and salt concentrations were similar for all lactose sources. In addition, the actual lactose and protein levels in each diet (Table 3) were similar to formulated values. The diets containing lactose, regardless of testing procedure, had markedly higher pellet durability indexes (PDI's) than the control diet containing no added lactose. Increases in PDI's were observed when the level of lactose was increased from 9 to 18%, regardless of source. However, diets containing either of the whey sources had superior PDI's, with diets containing Dairylac 80 having lower PDI's, regardless of procedure (Standard or Modified) used to determine PDI.

The mean of pigs fed additional lactose from d 0 to 14, regardless of source, was greater ($P<0.04$) and the mean ADFI tended to be greater ($P<0.07$) compared to pigs fed no supplemental lactose. The increased growth performance from additional lactose mainly occurred from d 0 to 7 of the experiment. Pigs fed edible grade whey had greater ADFI (linear and quadratic, $P<0$ .05) and tended to have increased ADG (linear, $P<0.06$) with increasing lactose from 9 to 18%. As whey level increased, ADG and ADFI were increased over the control diet, but no further improvement was observed in pigs fed 18% lactose. For pigs fed Dairylac 80, ADG and ADFI increased compared to those fed the no added lactose control. There were no further improvements in ADG or ADFI with increasing lactose above 9% (quadratic, $P<0.01$), but F/G improved (linear, $P<0.02$) as the level of lactose was increased from 9 to 18%. Pigs fed 9% granular whey and Dairylac 80 had similar performance to those fed 18% edible grade whey. No differences in pig growth performance were observed among sources of lactose used in this study.

It was evident by the increase in growth performance that additional lactose was beneficial to the nursery pigs in this study. Interestingly, only the edible grade whey source resulted in a linear improvement in ADG, which is commonly seen with increasing lactose in the diet. Pigs fed 9% lactose from Dairylac 80 had performance similar to pigs fed 18% lactose from edible grade whey. Increasing the lactose level to 18% did not further improve performance. This may be explained by the fact that pigs utilized in this study originated from a high health status operation and possibly may not have required as much lactose for maximal performance as is usually required under field conditions.

The slightly lower performance for pigs fed 18% lactose from Dairylac 80 compared with those fed 9% lactose from the same source may be a result of several factors. First, the decrease in performance may have been caused by a decrease in feed intake as additional fish meal was added to the diet. Fish meal was added to maintain a soybean meal level that was similar to the other lactose sources at the 18% lactose level. A second possibility may be that the slightly

lower threonine ratio relative to lysine in this diet limited ADFI and ADG.

For the granular whey source, growth performance improved from d 0 to 7 with the response similar to the response to Dairylac 80 with no benefit to adding more than 9% lactose from granular whey. In addition, there was no benefit to including granular whey in the diet from d 7 to 14 after weaning.

Results from this experiment indicate that additional lactose is beneficial for nursery pigs with the greatest requirement during the first 7 d after weaning. Similar to other experiments, the response to adding lactose to nursery diets declined rapidly as time increased postweaning. The lactose sources used in this experiment elicited similar growth performance.

Table 1. Composition of Experimental Diets

	Control	Dried Whey		Dairylac80	
Ingredient, % Lactose, %:	0	9	18	9	18
Corn	50.23	41.09	31.93	40.73	31.15
Soybean meal (46.5% CP)	34.77	31.83	28.90	31.82	28.87
Choice white grease	5.00	5.00	5.00	5.00	5.00
Spray-dried animal plasma	3.00	3.00	3.00	3.00	3.00
Select menhaden fish meal	2.00	2.00	2.00	3.90	5.80
Dried whey[a]	-	12.50	25.00	-	-
Dairylac 80[b]	-	-	-	11.25	22.50
Monocalcium phosphate (21% P)	1.55	1.15	0.80	1.00	0.40
Limestone	0.85	0.80	0.75	0.70	0.65
Salt	0.40	0.40	0.40	0.40	0.40
Vitamin premix	0.25	0.25	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15	0.15	0.15
Antibiotic[c]	1.00	1.00	1.00	1.00	1.00
Zinc oxide	0.38	0.38	0.38	0.38	0.38
Acidifier	0.20	0.20	0.20	0.20	0.20
L-lysine HCl	0.15	0.15	0.15	0.15	0.15
DL-methionine	0.08	0.10	0.10	0.08	0.10
Total	100.00	100.00	100.00	100.00	100.00
Calculated Analysis:					
Lysine, %	1.60	1.60	1.60	1.60	1.60
Methionine:lysine, %	28	29	28	28	30
Met & Cys:lysine, %	56	56	55	55	55
Threonine:lysine, %	61	62	63	60	59
Tryptophan:lysine, %	19	19	19	20	20
Isoleucine:lysine, %	62	62	62	61	60
Protein, %	24.0	23.4	22.8	23.6	23.2
ME, kcal/lb	1,576	1,570	1,564	1,593	1,609
Calcium, %	0.85	0.84	0.84	0.84	0.85
Phosphorus, %	0.82	0.78	0.75	0.78	0.74
Available phosphorus, %	0.50	0.50	0.51	0.51	0.50
Lysine:calorie ratio, g/Mcal	4.61	4.62	4.64	4.56	4.51

[a]Edible-grade (Land O'Lakes, Arden Hills, MN) or granular dried whey (International Ingredients Corp., St. Louis, MO).
[b]International Ingredients Corp., St Louis, MO.
[c]Provided 50 g per ton carbadox.

Table 2. Chemical Composition of Experimental Lactose Sources

Chemical Analysis, %	Edible Grade Whey[a]	Granular Whey[b]	Dairylac 80[b]
Lactose	72.8	72.1	80.2
Protein	11.5	12.3	5.01
Ash	7.99	7.93	8.02
Salt	3.07	2.80	2.98

[a]Land O'Lakes, Arden Hills, MN.
[b]International Ingredients Corp., St Louis, MO.

Table 3. Chemical Composition and Physical Characteristics of Experimental Diets

	Control	Edible Grade Whey[a]		Granular Whey[b]		Dairylac 80[b]	
Analysis Lactose, %:	0	9	18	9	18	9	18
Protein, %	24.9	23.8	23.2	24.0	23.5	23.3	23.8
Ash, %	6.86	6.81	7.53	6.93	7.20	7.37	7.61
Lactose, %	1.21	9.17	16.7	10.5	17.2	10.5	17.6
Pellet durability index, %							
Standard[c]	87.6	95.7	97.5	94.0	96.6	89.0	94.2
Modified[d]	71.6	89.3	95.0	87.6	93.3	80.0	87.4

[a]Land O'Lakes, Arden Hills, MN.
[b]International Ingredients Corp., St Louis, MO
[c]Am. Soc. Agric. Engin. Procedure.
[d]Am. Soc. Agric. Engin. Procedure modified with the addition of five ½-inch hexagonal nuts prior to tumbling.

Table 4. Effect of Lactose Source and Level on Nursery Pig Growth Performance[a]

	Control	Edible Grade Whey[b]		Granular Whey[c]		Dairylac 80[c]		
Item Lactose, %:	0	9	18	9	18	9	18	SEM
Day 0 to 7								
ADG, lb	0.37	0.40	0.48	0.51	0.49	0.52	0.45	0.04
ADFI, lb	0.35	0.37	0.45	0.43	0.45	0.45	0.39	0.03
F/G	0.95	0.93	0.94	0.84	0.92	0.87	0.87	0.05
Day 7 to 14								
ADG, lb	0.68	0.67	0.77	0.65	0.65	0.77	0.72	0.04
ADFI, lb	0.74	0.70	0.85	0.72	0.74	0.85	0.74	0.04
F/G	1.09	1.04	1.10	1.11	1.14	1.10	1.03	0.04
Day 0 to 14								
ADG, lb	0.52	0.53	0.62	0.58	0.56	0.64	0.58	0.03
ADFI, lb	0.55	0.53	0.65	0.58	0.60	0.65	0.56	0.02
F/G	1.06	1.00	1.05	1.00	1.07	1.02	0.97	0.04

[a]A total of 210 pigs (5 per pen and 6 pens per treatment) with an initial BW of 12.4 lbs.
[b]Edible grade whey was from Land O'Lakes, Arden Hills, MN.
[c]Granular whey and Dairylac 80 were from International Ingredients Corp., St Louis, MO.

Table 5. Probability of Lactose Source and Level on Nursery Pig Growth Performance[a]

Item	Control vs. Others	Edible[b] vs. Granular[c]	Edible vs. Dairylac[c]	Granular vs. Dairylac	Edible		Granular		Dairylac	
					Lin	Quad	Lin	Quad	Lin	Quad
Day 0 to 7										
ADG, lb	0.02	0.11	0.23	0.66	0.09	0.64	0.02	0.07	0.12	0.03
ADFI, lb	0.02	0.23	0.68	0.42	0.03	0.30	0.01	0.38	0.33	0.03
F/G	0.25	0.21	0.13	0.77	0.81	0.99	0.39	0.02	0.10	0.57
Day 7 to 14										
ADG, lb	0.61	0.11	0.61	0.04	0.18	0.34	0.65	0.86	0.51	0.16
ADFI, lb	0.47	0.25	0.52	0.08	0.09	0.09	0.99	0.78	0.98	0.01
F/G	0.99	0.09	0.78	0.15	0.99	0.32	0.49	0.84	0.22	0.18
Day 0 to 14										
ADG, lb	0.04	0.86	0.24	0.18	0.06	0.36	0.27	0.33	0.11	0.01
ADFI, lb	0.07	0.84	0.50	0.38	0.01	0.05	0.23	0.88	0.63	0.01
F/G	0.23	0.90	0.28	0.23	0.88	0.37	0.94	0.08	0.02	0.66

[a]A total of 210 pigs (five per pen and six pens per treatment) with an initial BW of 12.4 lb.
[b]Edible grade whey was from Land O'Lakes, Arden Hills, MN.
[c]Granular whey and Dairylac 80 were from International Ingredients Corp., St Louis, MO.