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Abstract

Three hundred thirty-three nursery pigs (initially 23.7 lb) were used in a 21-d growth assay to determine the lysine bioavailability of spray-dried blood meal, blood cells, and crystalline lysine on growth performance. Regardless of lysine source, ADG improved linearly as dietary lysine increased. However, pigs fed diets containing blood cells gained faster then those fed diets with spraydried blood meal. Pigs fed diets containing crystalline lysine and blood cells had greater ADFI then pigs fed spray-dried blood meal. Feed efficiency improved by 11.6, 13.6, and 12.7% with increasing amounts of L-lysine HCl, spray-dried blood meal, and blood cells, respectively. If L-lysine has a lysine bioavailability of 100%, the lysine bioavailabilities of spray-dried blood meal and blood cells, as determined by a sloperatio, were 103 and 102%, respectively.; Swine Day, Manhattan, KS, November 16, 2000

Keywords

Swine day, 2000; Kansas Agricultural Experiment Station contribution; no. 01-138-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 858; Swine; Nursery pigs; Lysine; Spray-dried blood meal; Blood cells

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COMPARISONS OF LYSINE BIOAVAILABILITY IN SPRAY-DRIED BLOOD MEAL, BLOOD CELLS, AND CRYSTALLINE LYSINE IN NURSERY PIGS

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Summary

Three hundred thirty-three nursery pigs (initially 23.7 lb) were used in a 21-d growth assay to determine the lysine bioavailability of spray-dried blood meal, blood cells, and crystalline lysine on growth performance. Regardless of lysine source, ADG improved linearly as dietary lysine increased. However, pigs fed diets containing blood cells gained faster then those fed diets with spray-dried blood meal. Pigs fed diets containing crystalline lysine and blood cells had greater ADFI then pigs fed spray-dried blood meal. Feed efficiency improved by 11.6, 13.6, and 12.7% with increasing amounts of L-lysine HCl, spray-dried blood meal, and blood cells, respectively. If L-lysine has a lysine bioavailability of 100%, the lysine bioavailabilities of spray-dried blood meal and blood cells, as determined by a slope-ratio, were 103 and 102%, respectively.

(Key Words: Nursery Pigs, Lysine, Spray-Dried Blood Meal, Blood Cells.)

Introduction

The use of specialty protein products or crystalline amino acids to replace a portion of soybean meal has become common practice in nursery diets. In addition, research has shown that amino acid digestibility is greater in some of these alternative sources compared to soybean meal. Furthermore, differences between sources can exist. In recent years, the use of spray-dried blood meal and blood cells in nursery diets has gained popularity with swine nutritionists as a means to reduce the amount of soybean meal. Therefore, our objective was to determine differences in lysine bioavailability between spray-dried blood meal, blood cells, and crystalline lysine.

Procedures

A total of 330 pigs (BW of 23.7 lb) was used in a 21-d growth assay. Pigs were blocked by weight and allotted to one of 11 dietary treatments. 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 water to provide ad libitum access to feed and water.

Diets for the experiment included both a negative (.95% lysine) and positive (1.40% lysine) control with no added blood products or crystalline lysine (Table 1). Additional treatment diets were formulated to increase the lysine level in the negative control diet by .15% increments (1.10, 1.25, and 1.40%) through the addition of L-lysine HCl, spray-dried blood meal, or blood cells. Corn and soybean meal were held constant in all diets except the positive control, so changes in the levels of the above ingredients were determined by the lysine level. In addition, all diets were formulated to equal levels of energy, sodium, and chloride. Increased amounts of crystalline amino acids (methionine, threonine, isoleucine, tryptophan, and valine) were included in the diet as lysine concentration rose, especially for the diets containing no blood products to maintain a

[1]Food Animal Health and Management Center.

minimum ratio as suggested by the NRC (1998). Average daily gain, ADFI, and F/G were determined by weighing pigs and measuring feed disappearance on d 7, 14, and 21 of the treatment period.

Data were analyzed as a randomized complete block design with pen as the experimental unit. Linear and quadratic polynomial contrasts were used to determine the effects of increasing lysine levels from crystalline lysine, spray-dried blood meal, and blood cells in the diet.

Results and Discussion

Overall, pigs fed the positive control diet had improved ADG and feed efficiency compared to those fed the negative control diet (P<.001; Table 2). Regardless of lysine source, ADG improved linearly (P<.05) as dietary lysine increased. Pigs fed diets containing blood cells gained faster (P<.02) then those fed spray-dried blood meal. Average daily feed intake tended to decrease linearly (P<.08) with increasing spray-dried blood meal. In addition, a quadratic decrease (P<.001) in ADFI occurred with increasing amounts of crystalline lysine in the diet. However, pigs consumed more of diets containing crystalline lysine (P<.001) and blood cells (P<.01) compared to diets with spray-dried blood meal. This indicates that spray-dried blood meal may be less palatable to pigs when fed at high levels (>5%). The reduction in intake conflicts with other research indicating an increase in feed consumption with elevated levels of spray-dried blood meal compared to blood cells. However, that research was conducted with smaller and younger pigs, which may indicate a possible decrease in palatability for spray-dried blood meal as pigs get older.

As the lysine level increased in the diet, pigs had a linear improvement in F/G (P<.007), regardless of lysine source. Feed efficiency increased by 11.6, 13.6, and 12.7% when they consumed diets with increasing amount of synthetic lysine, spray-dried blood meal, and blood cells, respectively.

To determine the lysine bioavailability of spray-dried blood meal and blood cells relative to synthetic lysine, a slope-ratio of the efficiency of gain response was utilized. If L-lysine has a lysine bioavailability of 100%, the lysine bioavailabilities of spray-dried blood meal and blood cells were 103 and 102%, respectively. These data are in agreement with previous research showing that blood meal (ring-dried) had a greater lysine bioavailability than crystalline lysine. This is supported by the fact that pigs in our study were more efficient when fed diets containing spray-dried blood meal (P<.03) and tended to be more efficient when fed diets containing blood cells (P<.14) compared to diets containing crystalline lysine.

These findings indicate that the use of blood products in diets is beneficial for increasing efficiency of gain compared to the use of crystalline lysine. Furthermore, the lysine bioavailability of spray-dried blood meal and blood cells is equal to or slightly greater than that of crystalline lysine.

Table 1. Diet Compositions (As-Fed Basis)

Item	Negative Control	L-Lysine HCl			Blood Meal			Blood Cells			Positive Control
	.95[a]	1.10%	1.25%	1.40%	1.10%	1.25%	1.40%	1.10%	1.25%	1.40%	1.40%
Corn	58.070	58.070	58.070	58.070	58.070	58.070	58.070	58.070	58.070	58.070	49.612
Soybean meal, 46.5%	26.458	26.458	26.458	26.458	26.458	26.458	26.458	26.458	26.458	26.458	42.086
Soy oil	2.987	3.090	3.269	3.577	3.433	3.901	4.409	3.425	3.884	4.414	3.932
Corn starch	8.000	7.514	6.839	5.893	5.571	3.076	.498	5.758	3.445	.982	-
Spray-dried blood meal	-	-	-	-	2.013	4.027	6.040	-	-	-	-
Blood cells	-	-	-	-	-	-	-	1.763	3.525	5.288	-
Monocalcium P, 21%	1.683	1.683	1.683	1.683	1.656	1.630	1.604	1.683	1.683	1.683	1.581
Limestone	.891	.975	.975	.975	.854	.817	.781	.921	.952	.973	.810
Salt	.428	.408	.345	.283	.406	.383	.361	.402	.376	.350	.425
Antibiotic[b]	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Vitamin premix	.250	.250	.250	.250	.250	.250	.250	.250	.250	.250	.250
Trace mineral premix	.150	.150	.150	.150	.150	.150	.150	.150	.150	.150	.150
Calcium chloride	.075	-	-	-	.099	.123	.147	.047	.019	-	.069
Sodium bicarbonate	-	.029	.121	.212	-	-	-	-	-	-	-
L-Lysine HCl	-	.190	.381	.571	-	-	-	-	-	-	-
DL-Methionine	.009	.079	.170	.261	.037	.087	.137	.053	.119	.185	.069
L-Threonine	-	.080	.182	.284	.003	.028	.053	.020	.061	.103	.016
L-Isoleucine	-	-	.016	.106	-	-	.044	-	-	.080	-
L-Tryptophan	-	.025	.057	.089	-	-	-	-	.007	.015	-
L-Valine	-	-	.035	.139	-	-	-	-	-	-	-
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Calculated analysis											
Lysine, %	.95	1.10	1.25	1.40	1.10	1.25	1.40	1.10	1.25	1.40	1.40
Met:lysine ratio, %	30	32	36	38	30	32	34	31	34	36	31
Met & cys:lysine ratio, %	62	60	60	60	60	60	60	60	60	60	60
Threonine:lysine ratio, %	69	67	67	67	67	67	67	67	67	67	67
Isoleucine:lysine ratio, %	77	67	60	60	69	62	60	68	60	60	75
Choride, %	.19	.19	.19	.19	.19	.19	.19	.19	.19	.19	.19
Soduim, %	.32	.32	.32	.32	.32	.32	.32	.32	.32	.32	.32
ME, kcal/lb	1,565	1,565	1,565	1,565	1,565	1,565	1,565	1,565	1,565	1,565	1,565

[a]Calculated lysine level.

[b]Provided 50 g/ton carbadox.

Table 2. Effects of Source and Level of Dietary Lysine on Growth Performance of Phase III Nursery Pigs[a]

	Negative Control	L-Lysine Hcl			Blood Meal			Blood Cells			Positive Control
Item	.95[b]	1.10%	1.25%	1.40%	1.10%	1.25%	1.40%	1.10%	1.25%	1.40%	1.40%
Day 0 to 7											
ADG, lb	.97	1.14	1.07	1.25	1.07	1.15	1.18	1.08	1.23	1.25	1.27
ADFI, lb	1.46	1.54	1.41	1.60	1.50	1.41	1.42	1.47	1.53	1.49	1.47
F/G	1.51	1.35	1.32	1.28	1.40	1.23	1.20	1.36	1.24	1.19	1.16
Day 7 to 14											
ADG, lb	1.18	1.32	1.37	1.41	1.31	1.36	1.40	1.33	1.45	1.45	1.52
ADFI, lb	1.98	2.06	1.79	1.85	1.93	1.89	1.77	1.90	1.97	1.93	1.99
F/G	1.68	1.56	1.31	1.31	1.47	1.46	1.26	1.43	1.36	1.33	1.31
Day 14 to 21											
ADG, lb	1.33	1.50	1.52	1.65	1.52	1.53	1.52	1.45	1.55	1.63	1.55
ADFI, lb	2.51	2.49	2.44	2.51	2.40	2.29	2.21	2.47	2.43	2.39	2.41
F/G	1.89	1.66	1.61	1.52	1.58	1.50	1.45	1.70	1.57	1.47	1.55
Day 0 to 21											
ADG, lb	1.16	1.32	1.32	1.44	1.30	1.35	1.36	1.29	1.41	1.44	1.45
ADFI, lb	1.98	2.03	1.88	1.99	1.95	1.86	1.80	1.95	1.97	1.94	1.96
F/G	1.71	1.54	1.42	1.38	1.50	1.38	1.32	1.51	1.40	1.34	1.35
Final wt, lb	47.77	50.65	49.20	53.28	50.21	51.30	51.53	49.89	52.78	53.33	53.44

[a]A total of 330 pigs (five pigs per pen and 6 pens per treatment) with an average initial BW of 23.7 lb.

[b]Calculated lysine level in the diet.

Table 3. Probability of Source and Level of Dietary Lysine on Growth Performance of Phase III Nursery Pigs[a]

Item	Negative vs Positive Control	Positive vs Other 1.40% Lysine Diets	L-Lysine vs Blood Meal	L-Lysine vs Blood Cells	Blood Meal vs Blood Cells	L-Lysine		Blood Meal		Blood Cells		SE
						Lin	Quad	Lin	Quad	Lin	Quad	
Day 0 to 7												
ADG, lb	.001	.26	.57	.23	.08	.07	.03	.004	.29	.03	.27	.03
ADFI, lb	.84	.59	.04	.54	.15	.40	.01	.23	.36	.85	.43	.04
F/G	.001	.10	.13	.06	.73	.05	.94	.006	.15	.02	.49	.04
Day 7 to 14												
ADG, lb	.001	.04	.75	.24	.14	.06	.84	.23	.96	.07	.25	.04
ADFI, lb	.93	.10	.53	.60	.25	.06	.09	.31	.77	.60	.35	.07
F/G	.001	.91	.84	.75	.91	.02	.13	.13	.87	.31	.67	.06
Day 14 to 21												
ADG, lb	.001	.42	.30	.76	.46	.07	.40	.82	.58	.003	.69	.04
ADFI, lb	.22	.52	.001	.24	.001	.82	.51	.03	.87	.31	.96	.06
F/G	.001	.21	.02	.51	.09	.02	.68	.09	.58	.001	.43	.04
Day 0 to 21												
ADG, lb	.001	.17	.20	.24	.02	.004	.06	.05	.51	.001	.14	.02
ADFI, lb	.63	.24	.001	.65	.01	.20	.001	.08	.89	.86	.44	.04
F/G	.001	.96	.03	.14	.49	.001	.26	.007	.51	.001	.32	.03
Final wt, lb	.001	.65	.95	.08	.07	.08	.04	.07	.44	.08	.04	.65

[a]A total of 330 pigs (five pigs per pen and 6 pens per treatment) with an average initial BW of 23.7 lb.

[b]Calculated lysine level in the diet.