NUTRITION NOTES
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AMINO ACID IMBALANCE WITH EXCESS METHIONINE IN LATE-FINISHING PIGS: EFFECTS ON PERFORMANCE AND CARCASS QUALITY

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The outbreak of the Covid-19 Pandemic in the spring of 2020, resulted in the shutdown of numerous pork harvest facilities across the country. This resulted in many complications in the hog production supply chain with one key area involving slowing the growth of late-finishing market hogs to ensure pigs were marketable when facilities reopened. One method for reducing growth and feed intake would be using higher levels of amino acids to create what are called amino acid imbalances. Research in pigs (Edmonds and Baker, 1987) showed significant depressions in growth with 4% added Methionine (Met). In preliminary research involving a very severe amino acid imbalance (Edmonds and Smith, 2020) with late-finishing pigs, we observed dramatic weight losses of 3.6 lb per day with feed intakes of 1.75 lb per day from excess Met of 3.15% in low protein diets over a 3 day period. The purpose of this investigation was to study the effects of various constant and/or subsequent increases in DL-Met as a way to reduce feed intake and growth rate in late-finishing pigs over a five week period.

Experimental Design

Trial 1 consisted of six treatments. Treatment 1 consisted of the (NexGen®) Positive Control (PC) - which contained 11.7% CP and 0.72% SID Lys with four added amino acids (AA) for 35 days. Pigs on Treatment 2 received the diet containing 8.8% CP (94% corn, 3.75% soybean meal, minerals, vitamins, phytase and three AA) and 0.51% SID Lys but without (0%) any supplemental Met for 35 days. Treatment 3 consisted of the 8.8% CP diet with Met added at 1% (substituted for corn) for 35 days. Pigs on Treatment 4 were fed diets with Met added at a step up from 1% to 1.8% (8.8% CP plus 1, 1.2, 1.4, 1.6 and 1.8% added Met for d 0-7, 7-14, 14-21, 21-28 and 28-35 days, respectively). Treatment 5 consisted of the 8.8% CP diet along with Met added at 2% for 35 days. With Treatment 6 the diets contained Met added at a step up from 1.5% to 2.3% (8.8% CP plus 1.5, 1.7, 1.9, 2.1 and 2.3% added Met for d 0-7, 7-14, 14-21, 21-28 and 28-35 days, respectively).

Trial 2 consisted of three treatments. Treatment 1 consisted of the 8.8% CP diet with Met supplemented at 2% for 35 days. With Treatment 2 the diets contained Met added at a step up from 1.5% to 2.3% (8.8% CP plus 1.5, 1.7, 1.9, 2.1 and 2.3% added Met for days 0-7, 7-14, 14-21, 21-28 and 28-35, respectively). Pigs on Treatment 3 were fed diets with Met added at a step up from 2% to 2.8% (8.8% CP diet plus 2.0, 2.2, 2.4, 2.6 and 2.8% added Met for days 0-7, 7-14, 14-21, 21-28 and 28-35, respectively). The diets were formulated using the same ingredients described in Trial 1. Feed cost/day was calculated using ingredient prices from the fall of 2020.

Results

In Trial 1, pigs on the PC had greater gain (days 0-14) than pigs fed diets with no added Met (Table 1). During days 0-14, pigs on Met 1% had reduced gain and feed intake compared to the pig diets without added Met. When compared to pigs on diets without added Met after 14 days on test, the growth (or loss of 0.32 lb/day for Met 2%) of pigs was reduced with Met 1% followed by Met 1.0-1.8% and Met 1.5-2.3%. Cost/day during days 0-14 was less for pigs on Met 2.0% and Met 1.5-2.3% as opposed to pigs on Met 1.0% and 1.0-1.8%. Compared to Treatments 2 (0% Met) and 3, pigs on Treatments 4-6 had decreases in gains and feed intakes during d 14-35. Cost/day was less for pigs on Treatment 6 compared to Treatments 2 and 3.

Pigs on the PC had better gain compared to those pigs on diets without added Met for the 35 day test period (Table 1). Pigs on Met 1.0% had decreases in gains and feed intakes compared to those without added Met. Reductions in gain and feed intakes occurred with pigs on Met 1.0-1.8% as opposed to those on Met 1.0%. Furthermore, pigs on Met 2.0% and Met 1.5-2.3% had similar performance, while both of these treatments had marked reductions in gains, feed intakes and feed/gain compared to those on Met 1.0-1.8%. In addition, pigs on Met 2.0% and Met 1.5-2.3% had lower cost/day compared to those without added Met and Met 1.0%. In regard to carcass data, dressing percent was similar across all six treatments. Percent lean was better with the four added Met treatments compared to those without added Met. Fat depth was less for pigs on the four added Met treatments compared to the PC and those without added Met. Furthermore, the packer grade premiums were less for pigs on Met 2.0% and Met 1.5-2.3% as opposed to the other four treatments due to the packer paying less premium for a lighter carcass with the same percent lean. Substandard pigs were higher for pigs on Met 2% (5.4%) compared to pigs on the PC, Met 0%, Met 1.0% and Met 1.0-1.8%, which had none.

During days 0-14 in Trial 2, pigs on Met 2.0% and Met 2.0-2.8% had marked reductions in gains, feed intakes and cost/day compared to those on Met 1.5-2.3% (Table 2). In addition, during days 14-35 pigs on Met 2.0% and Met 1.5-2.3% had greater gains, feed intakes and cost/day as opposed to those on Met 2.0-2.8%. During days 0-35, pigs on Met 1.5-2.3% had a greater gain, feed intake and cost/day compared to those pigs on Met 2.0%. In turn, pigs on Met 2.0% had an improvement in gain and feed intake, but a higher cost/day as opposed to the pigs on Met 2.0-2.8%. Percent lean and dressing percent were similar across all three treatments with fat depth, loin depth and grade premium being greater with Met 1.5-2.3% compared to Met 2.0% and Met 2.0-2.8%. No significant differences occurred in regard to substandard pigs on the three treatments.

Table 1. Effect of dietary methionine on late-finishing performance and feed cost, Trial 1[1]

			Added DL-methionine, %			
ITEM	**PC**	**0**	**1.0**	**1.0 - 1.8**	**2.0**	**1.5 - 2.3**
Met, % (d 0-7)			1.0	1.0	2.0	1.5
Met, % (d 7-14)			1.0	1.2	2.0	1.7
Met, % (d 14-21)			1.0	1.4	2.0	1.9
Met, % (d 21-28)			1.0	1.6	2.0	2.1
Met, % (d 28-35)			1.0	1.8	2.0	2.3
Substandard[2], %	0[b]	0[b]	0[b]	0[b]	5.4[a]	4.7[ab]
d 0-14						
ADG, lb	2.38[a]	1.92[b]	1.29[ch]	0.92[d]	-0.32[f]	0.08[e]
ADF, lb	7.37[a]	7.43[a]	5.88[b]	5.53[b]	3.41[d]	4.13[c]
F/G	3.10[a]	3.90[a]	4.66[a]	6.14[a]	-12.76[b]	-1.64[ab]
Cost/day, ¢	59.30[a]	53.25[b]	48.34[c]	46.05[c]	31.61[e]	36.64[d]
d 14-35						
ADG, lb	2.09[a]	1.89[ab]	1.77[b]	1.27[c]	1.42[c]	1.17[c]
ADF, lb	7.58[a]	7.65[a]	6.72[b]	5.68[c]	5.57[c]	5.12[c]
F/G	3.62[b]	4.05[ab]	3.82[b]	4.52[a]	3.99[ab]	4.38[a]
Cost/day, ¢	61.01[a]	54.85[b]	55.31[ab]	50.29[bc]	51.70[bc]	48.18[c]
d 0-35						
ADG, lb	2.21[a]	1.91[b]	1.58[c]	1.13[d]	.72[e]	.73[e]
ADF, lb	7.49[a]	7.56[a]	6.39[b]	5.62[c]	4.70[d]	4.73[d]
F/G	3.39[c]	3.98[bc]	4.08[bc]	5.00[b]	6.82[a]	6.74[a]
Cost/lb Gain, ¢	27.33[c]	28.49[c]	33.53[bc]	43.25[b]	63.34[a]	61.94[a]
Cost/day	60.32[a]	54.21[b]	52.52[bc]	48.60[cd]	43.67[de]	43.56[e]
Carcass						
Fat depth, in	0.64[ab]	0.68[a]	0.61[bc]	0.58[cd]	0.56[cd]	0.53[d]
Loin depth, in	2.89[a]	2.79[ab]	2.87[a]	2.79[ab]	2.72[b]	2.71[b]
Percent lean	56.5[a]	55.9[b]	56.6[a]	56.5[a]	56.4[a]	56.5[a]
Dressing percent	75.5	75.1	75.8	75.5	75.8	75.0
Grade premium, $/cwt[3]	8.30[a]	7.78[ab]	7.77[ab]	7.25[b]	6.63[c]	6.54[c]

[1]4 pens/treatment; 17-18 pigs/pen; Initial weight/treatment = 241 lb
[2]A substandard pig had an average body weight of 19 to 31% below the average pen weight.
[3]Expressed on a carcass price via the packing plant.
a-e Means within rows with different superscripts are different (P < 0 .05) via LSD method for all-pairwise comparisons.

Table 2. Effect of dietary methionine on late-finishing performance and feed cost, Trial 2[1]

	Added DL-methionine, %		
ITEM	**2.0**	**1.5 - 2.3**	**2.0-2.8**
Met, % (d 0-7)	2.0	1.5	2.0
Met, % (d 7-14)	2.0	1.7	2.2
Met, % (d 14-21)	2.0	1.9	2.4
Met, % (d 21-28)	2.0	2.1	2.6
Met, % (d 28-35)	2.0	2.3	2.8
Substandard[2], %	5.58	1.74	1.39
d 0-14			
ADG, lb	-0.91[b]	0.06[a]	-0.89[b]
ADF, lb	2.27[b]	4.08[a]	2.29[b]
Cost/day, ¢	21.05[b]	36.12[a]	21.49[b]
d 14-35			
ADG, lb	0.81[a]	0.85[a]	0.37[b]
ADF, lb	4.06[b]	4.78[a]	3.09[c]
Cost/day, ¢	37.64[b]	44.91[a]	30.68[c]
d 0-35			
ADG, lb	0.13[b]	0.53[a]	-0.14[c]
ADF, lb	3.34[b]	4.50[a]	2.77[c]
Cost/day	31.00[b]	41.40[a]	27.01[c]
Carcass			
Fat depth, in	0.46[b]	0.52[a]	0.44[b]
Loin depth, in	2.58[b]	2.65[a]	2.54[b]
Percent lean	56.4	56.3	56.4
Dressing percent	75.3	75.7	76.2
Grade premium, $/cwt[3]	5.39[b]	6.15[a]	4.76[c]

[1]8 pens/treatment; 16-17 pigs/pen; Initial weight/treatment = 240 lb
[2]A substandard pig had an average body weight of 24 to 37% below the average pen weight.
[3]Expressed on a carcass price via the packing plant.
[a-c]Means within rows with different superscripts are different (P < 0.05) via LSD method for all-pairwise comparisons.

Discussion

As expected, pigs on the NexGen diet had greater gain and better feed/gain along with a lower cost/lb of gain compared to those on the low protein diet without added Met. But pigs on this low protein diet did have acceptable performance and carcass traits. We clearly showed that growth rates can be kept very low with either the 2.0% supplemental Met and the 1.5 to 2.3% added Met via the step up levels. In Trial 2 we created a more severe amino acid imbalance by starting with 2% added Met and increasing it to 2.8% during the final week of the 35 day trial. Remarkably, this treatment of 2.0 to 2.8% added Met resulted in overall (35 days) feed intakes of 2.77 lb per day with a loss in weight of 0.14 lb per day while feed cost/day was only $0.27/pig.

After 35 days on test, we observed a range of 1.4 to 5.6% of the pigs that were substandard in only the treatments with added Met at 2% and those step up treatments involving 1.5 to 2.3% and 2.0 to 2.8% supplemental Met. So how does a swine producer manage this small percentage of substandard animals while holding pigs with very high levels of added Met? If a standard diet can be fed to one or two pens in a large facility, then we would recommend that managers pull out pigs that are becoming very thin and losing excess weight and feed them this diet so that they can compensate and recover. In Trial 2, we sold all but 10 of the substandard pigs at the end of the 35 day test. These pigs (average weight of 162 lbs) were placed on the NexGen diet used in Trial 1 and gained 27, 21 and 18 lbs per pig from Days 0-7, 7-14 and 14-21, respectively. If it is not feasible to feed these poor doing pigs a standard diet due to a lack of an additional bulk bin, then one would need to sell them as light pigs to empty the barn which is a routine practice.

In the event of any market suspension that requires slowing the growth of finishing pigs, pork producers need dependable and economical dietary formulations that can reduce growth and maintain carcass quality. The data from this report with excess Met provide pork producers with feasible dietary strategies (Table 3) that do alter feed intake patterns based on an amino acid routinely used in the industry. A more in depth introduction, discussion and literature review can be found in Translational Animal Science (Edmonds and Smith, 2021).

Table 3. Proposed Holding Schemes for 35 Days

Average Daily Gain, lbs	DL-Methionine, % Constant	DL-Methionine, % Weekly Step Up
1.32 – 1.76	1.0	
.88 – 1.32		1.0 – 1.8
.44 - .88	2.0	1.5 – 2.3
0 - .44		2.0 – 2.8

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