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The effects of dietary glutamine, glycine, and sodium chloride concentration on nursery pig growth performance

Abstract

We conducted a trial to evaluate the effects of feeding added salt (0.38% in addition to the 0.35% already added to the diet) and a 0.70% addition of a blend of 50% glutamine and 50% glycine to weanling pigs as a substitute for spray-dried animal plasma. A total of 216 pigs (initial BW 12.4 Â± 1.9 lb and 21 Â± 2 d of age) were used, with six pigs per pen and six pens per treatment. Pigs were randomly allotted to pens, blocked by weight, and assigned to one of the six dietary treatments. The six treatments were a negative control diet based on corn-soybean meal, a positive contol diet containing 5% spray-dried animal plasma, and diets with high concentrations of synthetic amino acids. Diets were arranged in a 2 Ã— 2 factorial, with or without 0.7% of a 50:50 blend of glutamine and glycine and with or without added salt (0.38% more than the basal level of 0.35% in all diets). From d 0 to 7, ADG and ADFI increased (P<0.05) for the pigs fed the positive with all other treatments. Pigs fed the synthetic amino acid diets (glutamine:glycine and Na treatments) had improved (P<0.05) F/G, compared with that of pigs fed the negative and positive control diets. From d 7 to 14, pigs fed the positive control diet had increased ADG, compared with that of the pigs fed the negative control, but ADG did not differ from that of pigs on any of the four glutamine: glycine and Na treatment diets. Pigs fed the positive control diet had greater ADFI and improved F/G for d 7 to 14, compared with those of pigs in all other treatments. For the overall feeding period, (d 0 to 14), pigs fed the positive control diet had a numerical improvement in ADG, compared with that of pigs fed the synthetic amino acid diets. Pigs fed the positive control diet also had a greater (P<0.05) ADG and ADFI than those fed the negative control diet. The pigs fed the positive control diet consistently had greater ADFI than pigs in all other treatments. The increase in ADFI corresponds to the increase in ADG for the overall feeding period. The data suggest that adding spray-dried animal plasma to the diet improves ADFI and ADG, and it seems that synthetic amino acid diets containing added Na and a 0.70% dietary blend of 50:50 glutamine:glycine can not equal the response exhibited when spray-dried animal plasma is added to nursery pig diets. Pigs fed the synthetic amino acid diets did have greater growth performance than that of pigs fed the negative control diet. The addition of large amounts of salt or the glutamine:glycine blend to synthetic amino acid diets did not have any influence on pig performance in this experiment.; Swine Day, 2005, Kansas State University, Manhattan, KS, 2005

Keywords

Swine day, 2005; Summary Publication of Report of Progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 964; Kansas Agricultural Experiment Station contribution; no. 06-63-S; Nursery pig; Glutamine; Glycine; Sodium; Swine

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THE EFFECTS OF DIETARY GLUTAMINE, GLYCINE, AND SODIUM CHLORIDE CONCENTRATION ON NURSERY PIG GROWTH PERFORMANCE

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Summary

We conducted a trial to evaluate the effects of feeding added salt (0.38% in addition to the 0.35% already added to the diet) and a 0.70% addition of a blend of 50% glutamine and 50% glycine to weanling pigs as a substitute for spray-dried animal plasma. A total of 216 pigs (initial BW 12.4 ± 1.9 lb and 21 ± 2 d of age) were used, with six pigs per pen and six pens per treatment. Pigs were randomly allotted to pens, blocked by weight, and assigned to one of the six dietary treatments. The six treatments were a negative control diet based on corn-soybean meal, a positive contol diet containing 5% spray-dried animal plasma, and diets with high concentrations of synthetic amino acids. Diets were arranged in a 2 × 2 factorial, with or without 0.7% of a 50:50 blend of glutamine and glycine and with or without added salt (0.38% more than the basal level of 0.35% in all diets). From d 0 to 7, ADG and ADFI increased ($P<0.05$) for the pigs fed the positive control diet, compared with all other treatments. Pigs fed the synthetic amino acid diets (glutamine:glycine and Na treatments) had improved ($P<0.05$) F/G, compared with that of pigs fed the negative and positive control diets. From d 7 to 14, pigs fed the positive control diet had increased ADG, compared with that of the pigs fed the negative control, but ADG did not differ from that of pigs on any of the four glutamine: glycine and Na treatment diets. Pigs fed the positive control diet had greater ADFI and improved F/G for d 7 to 14, compared with those of pigs in all other treatments. For the overall feeding period, (d 0 to 14), pigs fed the positive control diet had a numerical improvement in ADG, compared with that of pigs fed the synthetic amino acid diets. Pigs fed the positive control diet also had a greater ($P<0.05$) ADG and ADFI than those fed the negative control diet. The pigs fed the positive control diet consistently had greater ADFI than pigs in all other treatments. The increase in ADFI corresponds to the increase in ADG for the overall feeding period. The data suggest that adding spray-dried animal plasma to the diet improves ADFI and ADG, and it seems that synthetic amino acid diets containing added Na and a 0.70% dietary blend of 50:50 glutamine:glycine can not equal the response exhibited when spray-dried animal plasma is added to nursery pig diets. Pigs fed the synthetic amino acid diets did have greater growth performance than that of pigs fed the negative control diet. The addition of large amounts of salt or the glutamine:glycine blend to synthetic amino acid diets did not have any influence on pig performance in this experiment.

(Key Words: Nursery Pig, Glutamine, Glycine, Sodium.)

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Introduction

The importance of starting pigs on feed is always emphasized to ensure long-term performance. Specialty proteins such as spray-dried animal plasma are added to weanling pig diets to stimulate feed intake. Spray-dried animal plasma is very expensive and, if it could be replaced by an alternate source, there is potential to reduce feed cost. Previous research has demonstrated that glutamine and glycine may aid in gut repair and maturation during the Phase 1 feeding period (d 0 to 14). Research also has demonstrated that increased Na and Cl in the diet can influence feed intake, and may have similar impacts to spray-dried animal plasma. Spray-dried animal plasma has a higher concentration of Na and Cl, as well as increased concentrations of glutamine and glycine, which may be contributing to the growth response demonstrated in pigs fed spray-dried animal plasma. Therefore, we evaluated the growth performance of weanling pigs fed diets in which the spray-dried animal plasma was replaced with high concentrations of synthetic amino acids, and with either added Na, 50:50 glutamine and glycine blend, or both Na and 50:50 glutamine and glycine blend.

Procedures

A total of 216 pigs (initial BW 12.4 ± 1.9 lb and 21 ± 2 d of age), were used in a 14-d growth assay, with 6 pigs per pen and 6 pens per treatment. Pigs were randomly allotted to pens, blocked by weight, and randomly allotted to one of six dietary treatments in a 2 × 2 factorial with a negative and positive control. The negative control was a simple diet based on corn soybean meal; the positive control diet had 5% spray-dried animal plasma added; the plasma replaced soybean meal in the negative control diet. The main effects in the factorial were a 0.70% addition of glutamine and glycine (50:50 glutamine:glycine blend) and added salt (0.38% added in excess of the basal content of 0.35% in all diets). The basal diet for the 2 × 2 factorial contained high concentrations of synthetic amino acids. The synthetic amino acids replaced spray-dried animal plasma to ensure that none of the essential amino acids were limiting. The minimum amino acid:lysine ratios used when adding the synthetic amino acids were 60% for isoleucine, 30% for methionine, 60% for methionine and cysteine, 65% for threonine, 16.5% for tryptophan, and 66% for valine. The high salt concentration was chosen to match the sodium (0.45%) provided by the spray-dried animal plasma in the diet. The 0.7% addition of the 50:50 glutamine:glycine blend was used to provide enough nonessential amino acids to reduce the lysine:CP ratio to 7.0. This treatment structure would allow us to determine whether the nonessential amino acids or sodium content were an important part of the response to spray-dried animal plasma normally found with nursery pigs.

The trial was conducted at the Kansas State Swine Teaching and Research Center. Pigs were housed in an environmentally controlled nursery, in 4 ft × 4 ft pens. Pigs were offered *ad libitum* access to food and water. Pigs and feeders were weighed on d 0, 7, and 14 after weaning to calculate ADG, ADFI, and F/G. Data was analyzed by using Proc MIXED procedures in SAS 8.1. Contrast statements were used to determine the differences between treatments.

Results and Discussion

From d 0 to 7, ADG and ADFI increased ($P<0.05$) for the pigs fed the positive control diet, but pigs fed the synthetic amino acid diets (glutamine:glycine and Na factorial) had an improved ($P<0.05$) F/G, compared with pigs fed the negative and positive control diets. This data is consistent with previous results demonstrating that increasing the synthetic amino acids in a diet improves F/G. When synthetic amino acids are added to the diet, total soybean meal is reduced, resulting in higher calculated net energy, which may be the reason for the improved F/G. The improvement in F/G corresponded to numerically greater ADG, compared with that from the negative control diet. The numerical improvement in ADG was much less than that achieved by the addition of spray-dried animal plasma in the positive control diet. Diets containing spray-dried animal plasma consistently result in increased ADG corresponding to an increase in feed intake.

From d 7 to 14, pigs fed the positive control diet had improved ADG, compared with those fed the negative control, but they did not differ from pigs fed the synthetic amino acid diets. Pigs fed the synthetic amino acid diets maintained the improved F/G demonstrated from d 0 to 7. Feed efficiency for pigs fed the synthetic amino acid diet was less than for pigs fed the positive control, with pigs fed the negative control being intermediate. Pigs fed the positive control diet had greater ADFI than pigs in all other treatments had.

For the overall feeding period, (d 0 to 14), pigs fed the positive control diet had a numerical improvement in ADG, compared with that of pigs fed the synthetic amino acid diets, and an increase ($P<0.05$) in ADG, compared with that of pigs fed the negative control diet. The pigs fed the positive control diet consistently had greater ($P<0.05$) ADFI than pigs in all other treatments. Similar to the d 0-to-7 and the d 7-to-14 feeding periods, for the overall period, pigs fed the synthetic amino acid diets had improved F/G, compared with that of pigs fed either the negative or positive control diets.

The data suggest that adding spray-dried animal plasma improves ADFI and ADG, and it seems that diets containing high concentrations of synthetic amino acid, whether they contain high concentrations of salt and the glutamine:glycine blend or not, can not equal the response exhibited when adding spray-dried animal plasma to nursery pig diets, but these diets do result in greater growth response than the negative control diet. The addition of high concentrations of salt or the glutamine:glycine blend to the synthetic amino acid diets did not influence pig performance in this experiment.

Table 1. Composition of Diets (As-fed Basis)

			Added Salt			
	Control Diets		Added Glutamine and Glycine			
Item	Negative	Positive	-	+	-	+
Corn	41.14	48.83	50.89	50.89	50.89	50.89
Soybean meal (46.5% CP)	40.56	27.98	28.02	28.02	28.02	28.02
Monocalcium P (21% P)	1.50	1.20	1.60	1.60	1.60	1.60
Limestone	0.83	1.08	0.90	0.90	0.90	0.90
Salt	0.35	0.35	0.35	0.35	0.73	0.73
Vitamin premix	0.25	0.25	0.25	0.25	0.25	0.25
Trace mineral premix	0.15	0.15	0.15	0.15	0.15	0.15
Sand	---	---	0.38	0.38	---	---
Corn starch	---	---	1.35	---	1.35	---
L-threonine	0.04	0.01	0.23	0.23	0.23	0.23
L-glycine	---	---	---	0.35	---	0.35
Amino Gut® [a]	---	---	---	1.00	---	1.00
L-isoleucine	---	---	0.08	0.08	0.08	0.08
L-valine	---	---	0.09	0.09	0.09	0.09
L-tryptophan	---	---	0.01	0.01	0.01	0.01
L-lysine HCl	0.06	0.06	0.47	0.47	0.47	0.47
DL-methionine	0.13	0.10	0.25	0.25	0.25	0.25
Spray-dried porcine plasma	---	5.00	---	---	---	---
Spray-dried whey	15.00	15.00	15.00	15.00	15.00	15.00
Total	100.00	100.00	100.00	100.00	100.00	100.00
Calculated analysis						
TID lysine, %	1.35	1.35	1.35	1.35	1.35	1.35
Total lysine, %	1.51	1.50	1.48	1.48	1.48	1.48
Total lysine:protein ratio, %	6.21	6.50	7.34	6.99	7.34	6.99
ME, kcal/lb	1,482	1,496	1,458	1,458	1,459	1,459
Protein, %	24.4	23.0	20.2	21.2	20.2	21.2
Ca, %	0.85	0.86	0.86	0.86	0.86	0.86
P, %	0.82	0.78	0.78	0.78	0.78	0.78
Available P, %	0.50	0.50	0.51	0.51	0.51	0.51
Lysine:calorie, g/Mcal	4.63	4.54	4.61	4.61	4.61	4.61
Sodium, %	0.30	0.45	0.30	0.30	0.45	0.45
Chloride, %	0.48	0.55	0.56	0.56	0.78	0.78
Potassium, %	1.30	1.07	1.06	1.06	1.06	1.06

[a]Amino Gut® (Ajinomoto Heartland, Eddieville, IA) provided the 0.35 % glutamine in the diet.

Table 2. Effect of High Concentrations of Salt and a Glutamine:Glycine Blend on Pig Performance[a]

			Added Salt				
	Control Diets		Added Glutamine and Glycine				
Item	Negative	Positive	-	+	-	+	SE
d 0 to 7							
ADG	0.27[b]	0.41[c]	0.30[b]	0.32[b]	0.33[bc]	0.29[b]	0.02
ADFI	0.36[b]	0.46[c]	0.34[b]	0.37[b]	0.33[b]	0.32[b]	0.03
F/G	1.34[b]	1.14[b]	1.25[b]	1.16[b]	1.02[c]	1.08[c]	0.09
d 7 to 14							
ADG	0.78[b]	0.89[c]	0.86[bc]	0.82[bc]	0.81[bc]	0.82[bc]	0.05
ADFI	0.94[b]	1.14[c]	0.97[b]	0.95[b]	0.95[b]	0.91[b]	0.06
F/G	1.21[bc]	1.28[b]	1.12[c]	1.15[c]	1.19[c]	1.11[c]	0.04
d 0 to 14							
ADG	0.52[b]	0.65[c]	0.58[bc]	0.57[bc]	0.58[bc]	0.56[bc]	0.03
ADFI	0.65[b]	0.80[c]	0.65[b]	0.66[b]	0.64[b]	0.61[b]	0.04
F/G	1.24[b]	1.23[b]	1.13[c]	1.15[c]	1.11[c]	1.11[c]	0.03

[a]A total of 216 pigs (initial BW 12.4 ± 1.9 lb and 21 ± 2 d of age), were used in a 14-d growth assay, with 6 pigs per pen and 6 pens per treatment.
[b,c]Means in same row with different superscripts differ ($P<0.05$) .