Determining the Effects of L-Tryptophan Addition to Diets Containing 30% Dried Distillers Grains with Solubles on Finishing Pig Growth Performance[1]

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Summary

A total of 845 pigs (PIC 380 × Mosanto; initially 163 lb) were used in a 61-d study to determine the effects of L-tryptophan addition to diets containing 30% dried distillers grains with solubles (DDGS) on the growth performance of finishing pigs reared in a commercial environment. Pens of pigs were balanced by initial weight and randomly allotted to 1 of 5 dietary treatments in a completely randomized design with 25 to 30 pigs per pen and 6 replications per treatment. Treatments included 4 standardized ileal digestible (SID) tryptophan:lysine ratios (15, 17, 19, and 21% of lysine) using crystalline L-tryptophan added to the 15% diet. An additional diet used soybean meal as a source of tryptophan to provide a SID tryptophan:lysine ratio of 21%.

Overall (d 0 to d 61), increasing the SID tryptophan:lysine ratio did not affect ($P > 0.25$) growth performance. Pigs fed a diet containing a 21% SID tryptophan:lysine ratio with added soybean meal as the tryptophan source had ($P = 0.01$) poorer F/G compared with pigs fed the diet with a 21% SID tryptophan:lysine ratio from crystalline tryptophan. Although not significant, pigs fed the 21% SID tryptophan:lysine ratio with soybean meal as the tryptophan source had a 3% reduction in ADG compared with those fed a SID tryptophan:lysine ratio of 21% using L-tryptophan. Otherwise, ADG and ADFI ($P = 0.37$, $P = 0.82$) were similar across all treatments. In conclusion, increasing the SID tryptophan:lysine ratio from 15 to 21% by adding crystalline tryptophan (L-tryptophan) did not influence finishing pig growth performance.

Key words: SID tryptophan:lysine ratio, tryptophan, DDGS, growth, finishing pig

Introduction

In U.S. finishing pig diets, use of high levels of DDGShas become common. Tryptophan is the second limiting amino acid after lysine in diets containing high levels of DDGS. Previous research[4] at Kansas State University has demonstrated an optimal SID tryptophan:lysine ratio of greater than 18% in diets containing high levels (30%) of DDGS for pigs greater than 160 lb BW. In those trials, adding crystalline L-tryptophan to a diet containing a 15% SID tryptophan:lysine ratio to make a diet with

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[3] Ajinomoto Heartland LLC, Chicago, IL.

[4] Barnes et al., Swine Day 2010, Report of Progress 1038, pp. 156-165.

an 18% SID tryptophan:lysine ratio improved growth performance. The tryptophan-supplemented diet resulted in similar ADG and F/G for pigs fed a diet containing 18% SID tryptophan:lysine ratio where soybean meal was used as the source tryptophan. In contrast, the National Swine Nutrition guide[5] recommends a SID tryptophan:lysine ratio for this BW range of 16% of lysine.

Thus, the objective of this trial was to confirm previous findings for the optimal SID tryptophan:lysine ratio for finishing pigs fed diets containing 30% DDGS using L-tryptophan or soybean meal additions to increase the SID tryptophan:lysine ratio.

Procedures

The K-State Institutional Animal Care and Use Committee approved the protocol used in this experiment. The study was conducted at the commercial research-finishing barn in Illinois. Daily feed additions to each pen were accomplished through a robotic feeding system (FeedPro; Feedlogic Corp., Willmar, MN) capable of providing and measuring feed amounts for individual pens.

A total of 845 pigs (PIC 380 × Mosanto) with an initial body weight of 163 lb were used in this study. A similar number of barrows and gilts were placed in each pen with 25 to 30 pigs per pen with the average number of pigs per pen similar across treatments and 6 pens per treatment. Pigs were fed a pretest diet containing 35% DDGS before the start of the experiment (Table 1). When pigs reached 163 lb, pens of pigs were allotted to 1 of the 5 dietary treatments in a completely randomized design while balancing for initial BW. Treatments were diets with 4 SID tryptophan:lysine ratios (15, 17, 19, and 21%) using crystalline L-tryptophan. An additional treatment diet contained a SID tryptophan:lysine ratio of 21% where soybean meal was used as the source of tryptophan. All diets were fed in meal form and fed in 3 phases from d 0 to 21 (163 to 210 lb), d 21 to 42 (210 to 250 lb), and d 42 to 61 (250 lb to market) (Tables 1 and 2). All diets contained 30% DDGS except diets fed in the last phase, in which DDGS level was lowered to 15% to reduce the impact on carcass fat quality and yield. Diets in Phase 3 also contained 6.75 g/ton of Ractopamine HCl (Paylean; Elanco Animal Health, Greenfield, IN).

Pens of pigs were weighed and feed disappearance was recorded at d 10, 21, 31, 42, and 61 to determine ADG, ADFI, and F/G. On d 42 of the experiment, the 4 heaviest pigs (2 barrows and 2 gilts, determined visually) per pen were weighed and sold according to the farm's normal marketing procedure.

The experimental data were analyzed using the MIXED procedure of SAS (SAS institute, Inc., Cary, NC). Data were analyzed for the linear and quadratic effects of increasing SID tryptophan:lysine ratio. A single contrast was used to compare the 2 diets with SID tryptophan:lysine ratios of 21% made with either L-tryptophan or soybean meal. Pen was the experimental unit for all data analysis, and significance and tendencies were set at $P < 0.05$ and $P < 0.10$, respectively.

[5] National Swine Nutrition Guide. 2010. Growing-Finishing Swine Nutrient Recommendations and Feeding Management, U.S. Pork Center of Excellence, Ames, IA.

Results and Discussion

For the overall period (d 0 to 61), increasing SID tryptophan:lysine ratio had no effect ($P > 0.25$) on growth performance (Table 3). Pigs fed diet containing 21% SID tryptophan:lysine ratio from crystalline L-tryptophan had better F/G ($P = 0.01$) than pigs fed the diet with increased soybean meal as the source of tryptophan. Poor feed efficiency in the diet containing 21% SID tryptophan:lysine ratio in which soybean meal was the source of tryptophan might be a result of excess CP. The high soybean meal-containing diet had 20.4, 18.9, and 20.2% CP in Phases 1, 2, and 3, respectively. In contrast, L-tryptophan supplemented diet containing 21% SID tryptophan:lysine ratio had 17.4, 16.2, and 16.7% CP in Phases 1, 2, and 3, respectively (Tables 1 and 2). Thus, the excess individual amino acids in the diets with a higher amount of soybean meal may have contributed to the poorer F/G.

In conclusion, increasing SID tryptophan:lysine ratio from 15 to 21% by adding crystalline L-tryptophan did not influence growth performance; however, because of the excellent feed intake in this experiment, the diets fed were probably over the pigs' dietary lysine requirement. Therefore, when evaluating tryptophan intake as a ratio to the estimated SID lysine requirement, even the lowest SID tryptophan:lysine ratio fed in this experiment could have been above the SID tryptophan:lysine ratio requirement of pigs in this BW range.

Table 1. Composition of diets (Phase 1, 163 to 200 lb; as-fed basis)

		Tryptophan source	
Item	Pretest diet[1]	L-Tryptophan[2]	Soybean meal[3]
Ingredient, %			
Corn	52.20	60.04	51.47
Soybean meal, 46.5%	10.79	7.88	16.76
DDGS[4]	35.00	30.00	30.00
Limestone	1.15	1.15	1.15
Salt	0.35	0.35	0.35
Trace mineral premix	0.08	0.08	0.08
Vitamin premix	0.08	0.08	0.08
L-Lysine HCl	0.36	0.41	0.12
L-Threonine	---	0.03	---
L-Tryptophan	---	---	---
Total	100	100	100
Calculated analysis			
Standadized ileal digestible (SID) amino acids, %			
Lysine	0.85	0.80	0.80
Isoleucine:lysine	70	66	84
Leucine:lysine	206	200	226
Methionine:lysine	36	34	40
Met & Cys:lysine	73	70	81
Threonine:lysine	66	65	77
Tryptophan:lysine	16.5	15.0	21.0
Valine:lysine	87	83	101
Phenylalanine:lysine	93	88	108
Tyrosine:lysine	68	63	79
Total lysine, %	1.02	0.95	0.97
ME, kcal/lb	1,525	1,526	1,523
SID lysine:ME, g/Mcal	2.53	2.38	2.38
CP, %	19.3	17.3	20.4
Ca, %	0.50	0.49	0.52
P, %	0.47	0.44	0.47
Available P, %	0.23	0.20	0.21

[1] The pretest diet was fed for 3 wk before start of the experiment, from approximately 125 to 163 lb.
[2] L-Tryptophan was added at 0.016, 0.032, and 0.048% of the diet to provide SID tryptophan:lysine ratios of 17, 19, and 21% of lysine.
[3] Soybean meal was used as the source of tryptophan to achieve a SID tryptophan:lysine ratio of 21% of lysine.
[4] Dried distillers grains with solubles.

Table 2. Composition of diets (Phase 2 and Phase 3; as-fed basis)[1]

	Phase 2		Phase 3	
Tryptophan source	L-Tryptophan[2]	Soybean meal[3]	L-Tryptophan[4]	Soybean meal
Ingredient				
Corn	62.99	55.45	69.46	59.82
Soybean meal, 46.5%	4.99	12.78	13.39	23.36
DDGS[5]	30.00	30.00	15.00	15.00
Limestone	1.15	1.15	1.10	1.10
Salt	0.35	0.35	0.35	0.35
Trace mineral premix	0.08	0.08	0.08	0.08
Vitamin premix	0.08	0.08	0.08	0.08
L-lysine HCl	0.37	0.12	0.41	0.09
DL-methionine	---	---	0.015	---
L-threonine	---	---	0.09	0.09
L-tryptophan	---	---	---	---
Ractopamine HCl, 9 g/lb[6]	---	---	0.038	0.038
Total	100	100	100	100
Calculated analysis				
Standadized ileal digestible (SID) amino acids, %				
Lysine	0.70	0.70	0.90	0.90
Isoleucine:lysine	68	87	60	79
Leucine:lysine	218	245	163	189
Methionine:lysine	37	43	30	34
Met & Cys:lysine	77	87	60	69
Threonine:lysine	65	80	65	80
Tryptophan:lysine	15.0	21.0	15.0	21.0
Valine:lysine	88	106	73	91
Phenylalanine:lysine	93	113	77	97
Tyrosine:lysine	67	83	55	71
Total lysine, %	0.84	0.86	1.02	1.05
ME, kcal/lb	1,526	1,524	1,525	1,522
SID lysine:ME, g/Mcal	2.08	2.08	2.68	2.68
CP, %	16.2	18.9	16.7	20.2
Ca, %	0.48	0.51	0.49	0.52
P, %	0.42	0.46	0.39	0.44
Available P, %	0.20	0.21	0.13	0.14

[1] Phase 2 diets were fed from 210 to 250 lb BW and Phase 3 diets were fed from 250 lb BW until market.
[2] L-tryptophan was added at 0.014, 0.029, and 0.043% of the diet to provide SID tryptophan:lysine ratios of 17, 19, and 21% of lysine.
[3] Soybean meal was used as the source of tryptophan to achieve a SID tryptophan:lysine ratio of 21% of lysine.
[4] L-tryptophan was added at 0.018, 0.036, and 0.054% of the diet to provide SID tryptophan:lysine ratios of 17, 19, and 21% of lysine.
[5] Dried distillers grains with solubles.
[6] Ractopamine HCl (Paylean; Elanco Animal Health, Greenfield, IN) at 6.75 g/ton was added.

Table 3. Determining the effects of standardized ileal digestible (SID) tryptophan:lysine ratio in diets containing 30% dried distillers grains with solubles (DDGS) on growth performance of finishing pigs [1]

	SID tryptophan:lysine ratio, (% of lysine)						Probability, P <		
							Tryptophan		21%
Item	15[2]	17	19	21	Soybean meal 21[3]	SEM	Linear	Quadratic	(L-tryptophan vs. soybean meal)
Initial wt, lb	163.2	163.5	163.3	163.2	163.4	2.161	0.99	0.92	0.94
Final wt, lb	290.4	287.1	288.9	285.6	282.1	4.554	0.55	1.00	0.59
d 0 to 61									
ADG , lb	2.19	2.16	2.18	2.12	2.06	0.051	0.40	0.75	0.37
ADFI, lb	7.30	7.31	7.22	7.06	7.11	0.155	0.25	0.58	0.82
F/G	3.33	3.38	3.31	3.33	3.46	0.033	0.62	0.62	0.01

[1] A total of 845 pigs (PIC 380 × Monsanto; initially 163 lb) were used in a 61-d growing-finishing trial with 25 to 30 pigs per pen and 6 pens per treatment.
[2] L-Tryptophan was added to the 15% SID tryptophan:lysine diet to provide SID tryptophan:lysine ratios 17, 19, and 21% lysine.
[3] Soybean meal was used as the source of tryptophan to provide a SID tryptophan:lysine ration of 21%.