

167 Effect of Reducing Dietary Crude Protein on Growth Performance of Fattening Pigs: A Meta-Analysis.

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Abstract: Reducing dietary crude protein (CP) is a nutritional strategy implemented to improve the sustainability of pig production. Its effect on growth performance has been broadly studied in fattening pigs but the literature is lacking a quantitative summary of the knowledge acquired. A meta-analysis was performed to assess the effects of reducing dietary CP on pig growth performance. Articles included in the meta-analysis studied effects of CP reduction, with at least 3 CP levels, on the growth performance of fattening pigs (20-115 kg) and were published from 1990 to 2019. The database contained 42 articles, which correspond to 67 trials. Diet composition was recalculated with INRA-AFZ (2004) tables. Trials using iso-digestible lysine and iso-net energy diets with constant or above requirements levels of essential amino acids (EAA, METEX NØØVISTAGO recommendations) were selected for the final analysis, with a 5% acceptance limit. The final selection contained 11 trials and 44 treatments. The general linear model procedure of MINITAB (2019) was used to build regression models, including a fixed trial effect. Dietary CP reduction tested ranged between 1.6 and 7.5 percentage points (%pt) and was performed by reducing soybean meal and increasing cereals inclusion in all trials except one using rapeseed meal. Reducing dietary CP did not significantly impacted feed intake, average daily gain or feed conversion ratio when EAA were adequately supplied. Nitrogen efficiency was improved by 2.7 %pt per %pt of CP reduction ($P < 0.001$). No statistical analysis could be performed on carcass composition data as there were only 6 trials remaining after selection for these parameters, but fatter carcasses were observed in half of the trials. This study highlighted that few CP reduction studies have been performed while controlling energy and EAA levels. There was no effect of reducing dietary CP on growth performance when those parameters were controlled but more research is needed on very low CP diets for fattening pigs.

Keywords: crude protein, meta-analysis, pig nutrition

169 The Effect of Increasing Valine, Isoleucine, and Tryptophan:Lysine Ratios on Growth Performance and Carcass Characteristics of Pigs Fed Diets with High Leucine:Lysine.

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Abstract: A total of 4,076 pigs (initially 39.3 kg) were used across 2 experiments to evaluate the effect of increasing ratios of Val, Ile, and Trp:Lys in corn-soybean meal-DDGS-based diets on pig growth performance and carcass characteristics. In both experiments, the 4 dietary treatments were: 1) high soybean meal and low feed grade amino acids (control), 2) low soybean meal and high feed grade amino acids, with Val:Lys, Ile:Lys, and Trp:Lys at 67, 55, and 18, respectively, (low ratio) 3) diet 2 except Val:Lys, Ile:Lys, and Trp:Lys increased to 72, 60, and 21, respectively, (medium ratio), and 4) diet 2 except Val:Lys, Ile:Lys, and Trp:Lys at 80, 65, and 23, respectively (high ratio). The Leu:lys levels for the diets with increased synthetic amino acids ranged from 135 to 146 for the 4 phases. All diets contained 30% DDGS until 100 kg BW, and then 20% DDGS until trial completion. Because there was no experiment \times treatment interactions, data from both experiments were combined. Overall, ADG and ADFI increased (AA ratio; linear, $P < 0.05$) as Val, Ile, and Trp:Lys ratios increased from low to high. Pigs fed the control diet exhibited increased ADG compared with pigs fed low ratio diets, while pigs fed medium and high ratio diets performed intermediate. For carcass characteristics, pigs fed the control had increased ($P < 0.05$) percentage lean and loin depth compared with pigs fed the medium ratio diet, with pigs fed low and high ratio intermediate. Pigs fed the medium ratio diet had increased backfat depth compared with pigs fed the control, with pigs fed the low and high ratio intermediate ($P < 0.05$). In summary, the soybean meal level can be reduced, and synthetic amino acid levels increased in high DDGS diets as long as ratios of Val, Ile, and Trp to Lys are increased.

Table 1. Effects of branched-chain amino acid ratios on growth performance of pigs

Item ²	Control	Low ratio	Medium ratio	High ratio	SEM	P= ¹	
						AA Linear	AA Quadratic
Initial BW, kg	39.3	39.3	39.3	39.3	0.56	0.911	0.614
Final BW, kg	132.3	130.8	131.3	131.8	1.08	0.107	0.857
Overall							
ADG, kg	0.89 ^a	0.87 ^b	0.88 ^{ab}	0.88 ^{ab}	0.013	0.011	0.564
ADFI, kg	2.52	2.47	2.49	2.52	0.030	0.032	0.959
G:F, g/kg	352	352	353	351	2.72	0.728	0.705
Carcass characteristics							
HCV, kg	97.4	96.7	97.1	97.5	0.95	0.272	0.953
Carcass yield, %	73.4	73.7	73.6	73.7	0.32	0.968	0.784
Lean, %	57.0	56.6	56.3	56.5	0.25	0.866	0.081
Back fat depth, mm	14.0 ^a	14.6 ^{ab}	15.0 ^a	14.7 ^{ab}	0.27	0.614	0.213
Lozin depth, mm	68.6 ^a	67.1 ^{ab}	66.7 ^b	67.9 ^{ab}	0.49	0.166	0.147

¹Means within a row with different superscript differ ($P < 0.05$).
²Linear and quadratic contrasts were evaluated based on total Leu, Ile, Val, and Trp:Lys ratios per diet and compares means of the low-, medium- and high-ratios.
³The control diet contained high soybean meal and low feed grade amino acids with ratios to Lys ranging from 92 to 95% for Val, 79 to 83% for Ile, and 23% for Trp. The other 3 diets contained lower soybean meal levels and high feed grade amino acids with Val:Lys, Ile:Lys, and Trp:Lys increasing for the three treatments (Low, Medium, and High). For the low treatment, Val:Lys, Ile:Lys, and Trp:Lys were 67, 55, and 18, respectively. For the medium ratios, Val:Lys, Ile:Lys, and Trp:Lys were 72, 60, and 21, respectively. For the high ratios, Val:Lys, Ile:Lys, and Trp:Lys were 80, 65, and 23, respectively. The Leu:Lys levels ranged from 139 to 154% in the different diet phases for the three treatments with higher levels of feed grade L-Lys.

Keywords: branch chain amino acids, growth performance, pig

168 Evaluation of Increasing Dietary Threonine to Lysine Ratio in Corn-Soybean Meal Diets with and Without Dried Distillers Grains with Solubles (DDGS) on Growth Performance of Grow-Finish Pigs. Andres F. Tolosa Russi¹, Mike D. Tokach², Robert D. Goodband², Jordan T. Gebhardt², Jason C. Woodworth², Joel M. DeRouchey², ¹Kansas State University Applied Swine Nutrition Team, ²Kansas State University

Abstract: A total of 2,160 pigs (PIC 337×1050; initial BW 35.1 kg) were used in a 112-d growth trial to evaluate the effects of normal or high SID Thr:Lys ratio in diets with and without DDGS on growth performance. Pigs were assigned to pens (27 pigs per pen) in a randomized complete block design by BW with 20 replications per treatment. Pens of pigs were allotted to 1 of 4 dietary treatments arranged in a 2×2 factorial with main effects of dietary Thr level (Normal vs High) and DDGS (with or without). Treatment diets were formulated in 4 phases from 35 to 57, 57 to 82, 82 to 105, and 105 to 136 kg BW. Diets with high DDGS were formulated to include 40% DDGS in phase 1 and 2, 30% in phase 3, and 15% in phase 4. Normal Thr diets were formulated to contain 61, 62, 63, and 65% SID Thr:Lys ratios for the 4 dietary phases, respectively. High Thr diets had SID Thr:Lys ratios of 67, 68, 69 and 72%, respectively. There were no ($P > 0.10$) DDGS×Thr interactions. For the overall period (d 0 to 112), pigs fed diets without DDGS had increased ($P < 0.001$) ADG and BW, and reduced ($P < 0.001$) ADFI leading to improved ($P < 0.001$) G:F. There was no evidence for difference ($P > 0.10$) between diets with normal or high SID Thr:Lys ratio regardless of DDGS inclusion. In summary, the addition of high levels of DDGS reduced ADG and increased ADFI, which resulted in poorer G:F and lighter final BW, regardless of the dietary SID Thr:Lys ratio. These results indicate that addition of an insoluble fiber source, such as corn DDGS, does not increase the Thr:Lys requirement of finishing pigs.

Item	No DDGS		DDGS		SEM	P=		
	Normal Thr	High Thr	Normal Thr	High Thr		Thr	DDGS	Thr × DDGS
Day 0 to 112 (Overall)								
ADG, kg	0.92	0.92	0.90	0.90	0.006	0.973	<0.001	0.989
ADFI, kg	2.59	2.64	2.72	2.70	0.027	0.556	<0.001	0.252
Gain:feed	0.36	0.35	0.33	0.33	0.003	0.408	<0.001	0.164
Final BW, kg	136.6	136.9	133.6	133.3	0.803	0.972	<0.001	0.655

Keywords: DDGS, grow-finish pig, SID Thr.