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DIVISION OF AGRICULTURE
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Supplementation of reduced crude protein growing/finishing diets with synthetic amino acids

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Objective

- **Develop a 5-phase growing/finishing feeding program, with Paylean fed during the final 3-wk phase, that maximizes the use of crystalline amino acids without negatively impacting gain, carcass composition, or pork quality.**

Background

Some nitrogen from swine manure and urine is released into the atmosphere as nitrous oxide (N_2O). The greenhouse effect of N_2O is about 298 times that of CO_2; therefore, N_2O has an important impact on total global warming. Maximizing crystalline amino acid use and reducing dietary crude protein (CP) in swine diets has been shown to dramatically reduce nitrogen excretion. However, there was variability in growth performance and carcass characteristics when reduced crude protein diets were fed to growing/finishing swine. The situation is further complicated by FDA regulations requiring a 16% crude protein diet when feeding Paylean, though preliminary studies indicate lower crude protein diets with appropriate added amino acids could be fed without compromising performance or carcass composition of Paylean-fed pigs. These studies suggest the maximum level of crude protein reduction, in conjunction with the optimum amino acid inclusion rate, has not been sufficiently determined for widespread acceptance by the swine industry. Reducing the crude protein content of grower and finisher diets has been repeatedly shown to increase intramuscular fat content, whereas the reductions in intramuscular fat content, or marbling, anecdotally associated with feeding Paylean are more than likely a response to dietary lysine levels in excess of 0.8%.

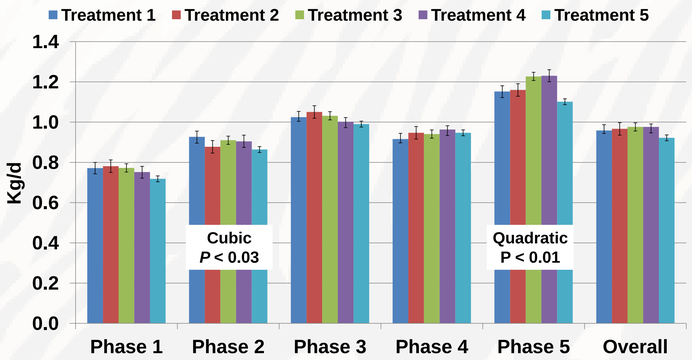
Methods

- 420 pigs (210 barrows, 210 gilts)
- Split sex fed
- 5 dietary treatments fed during 5 phases
  - Phase 1 (22 to 38 kg, 21 days)
  - Phase 2 (38 to 57 kg, 21 days)
  - Phase 3 (57 to 77 kg, 21 days)
  - Phase 4 (77 to 104 kg, 28 days)
  - Phase 5 (104 to 129 kg, 21 days); 10 ppm Paylean
- All indispensable amino acids were supplemented in diets to exceed the SID lysine to AA ratio recommendations by 2.0 percentage units for all phases of production.

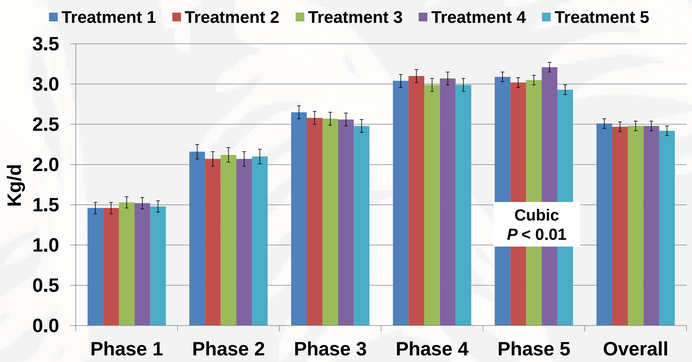
Description of Treatments

	Phase				
	1	2	3	4	5
SID Lys, Calculated (%)	1.01	0.86	0.74	0.65	0.90
Added Lys, Calculated (%)					
Treatment 1	---	---	---	---	---
Treatment 2	0.19	0.18	0.15	0.12	0.15
Treatment 3	0.38	0.36	0.29	0.24	0.30
Treatment 4	0.56	0.54	0.44	0.36	0.45
Treatment 5	0.75	0.72	0.59	0.48	0.60
CP, Analyzed (%)					
Treatment 1	23.67	21.53	18.97	17.66	20.24
Treatment 2	21.59	19.46	17.34	16.30	18.60
Treatment 3	19.56	17.44	15.74	14.96	17.01
Treatment 4	17.59	15.49	14.16	13.64	15.44
Treatment 5	15.74	13.61	12.68	12.31	13.93

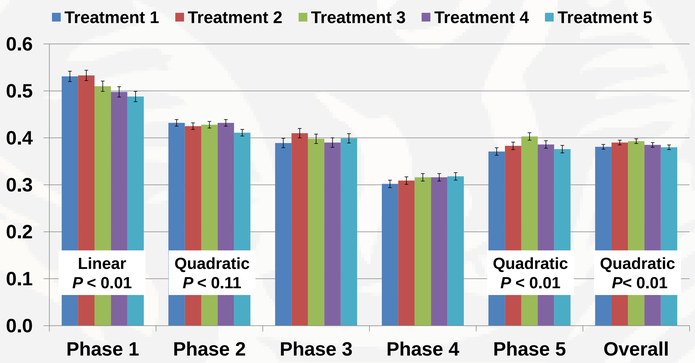
Average Daily Gain



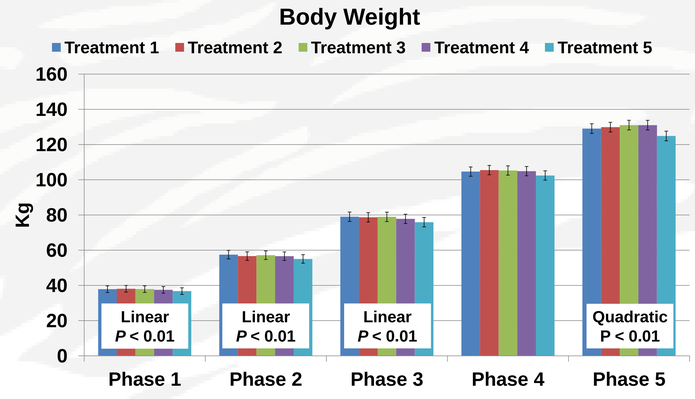
Average Daily Feed Intake



Gain:Feed



Body Weight



Main effects of reduced CP and gender on ultrasound measures of back fat (BF) depth, longissimus muscle area (LEA), and lean muscle weight in growing/finishing swine.

	Treatment					SEM	Sex		SEM	P-value	
	1	2	3	4	5		F	M		Trt	Sex
BF, mm											
Phase 1	6.51	6.92	6.99	7.44	7.37	0.31	6.86	7.23	0.27	0.0059	0.0290
Phase 2	8.54	8.80	9.50	8.80	9.45	0.36	8.53	9.50	0.25	0.1874	0.0024
Phase 3	13.32	13.31	13.50	13.38	14.40	0.49	12.08	15.10	0.32	0.4060	< 0.0001
Phase 4	20.80	20.94	21.00	21.93	22.50	0.95	18.36	24.51	0.76	0.3932	< 0.0001
Phase 5	23.36	22.93	23.84	24.65	24.82	0.84	20.44	27.39	0.69	0.1625	< 0.0001
LEA, cm^2											
Phase 1	18.38^{bc}	19.58^{a}	18.55^{bc}	19.19^{a}	18.25^{c}	0.96	19.07	18.51	0.92	0.0219	0.0566
Phase 2	26.31^{bc}	27.52^{a}	26.35^{bc}	26.77^{ab}	25.34^{c}	1.11	26.17	26.75	1.06	0.0096	0.1185
Phase 3	32.10^{a}	33.03^{a}	32.66^{a}	32.41^{a}	30.84^{b}	1.09	31.81	32.61	1.04	0.0107	0.0464
Phase 4	39.55	39.43	39.99	40.64	38.77	1.30	40.06	39.29	1.17	0.4623	0.2379
Phase 5	44.49^{a}	45.18^{a}	44.96^{a}	44.81^{a}	41.83^{b}	0.95	44.57	43.94	0.87	< 0.0001	0.1455
Lean, kg											
Phase 1	16.45^{a}	16.77^{a}	16.40^{a}	16.38^{a}	15.85^{b}	0.85	16.63	16.11	0.84	0.0154	0.0018
Phase 2	24.61^{a}	24.76^{a}	24.30^{a}	24.60^{a}	23.40^{b}	1.07	24.1	24.57	1.05	0.0022	0.0417
Phase 3	31.84^{a}	32.00^{a}	31.87^{a}	31.57^{a}	30.11^{b}	1.11	31.3	31.65	1.09	0.0004	0.2247
Phase 4	39.87	40.02	40.08	40.04	38.75	1.10	40.1	39.41	1.04	0.2131	0.1027
Phase 5	47.97^{a}	48.59^{a}	48.58^{a}	48.28^{a}	45.30^{b}	0.97	48.19	47.3	0.91	< 0.0001	0.0233

Conclusion

- **Overall, body weight, average daily gain, average daily feed intake and feed efficiency were similar or improved with lower inclusions of synthetic amino acids and declined at the highest inclusion.**
- **Our research indicates that synthetic amino acids up to 0.56% Lysine HCL in phase 1, 0.54% in phase 2, 0.44% in phase 3, 0.36% in phase 4, and 0.45% in phase 5 (with Paylean) may be included in the diet without negatively impacting gain and feed intake as long as all amino acid SID requirements are met.**
- **Studies are planned to determine the impact these diets will have on N excretion.**

Implications

- **Data from this study will be used to support enhancement of existing, or development of new robust and accurate, process-based animal growth, manure nutrient output, manure gas emissions and Life Cycle Assessment and Cost models. These models will allow better optimization of nutrient requirements, animal growth, and GHG emission from swine production systems.**

Acknowledgement

- **This research is part of the USDA NIFA-AFRI program "Climate Change Mitigation and Adaptation in Agriculture“ (Program code:A3141), and is supported by Agriculture and Food Research Initiative Competitive Grant no. 2011-68002-30208 from the USDA National Institute of Food and Agriculture. Project website: http://www.agroclimate.org/seclimate/. The project team is comprised of faculty, staff, and students from the following Universities: University of Arkansas, Purdue University, Virginia Technological University, and the University of Nebraska.**