The Peformance of Growing-Finishing Pigs Fed Diets with Reduced Crude Protein

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Summary

Successful formulation of low protein diets increases our flexibility in formulating practical diets, providing us with another tool to lower nitrogen output in the slurry and to reduce greenhouse gas emissions. This experiment compared the performance of pigs fed regular protein versus low protein diets. An intermediate protein diet was also employed.

Average daily gain, average daily feed intake and feed efficiency were unaffected by dietary treatment. Most carcass characteristics, including index, lean yield and backfat thickness were unaffected by treatment; however, loin muscle thickness was increased on the low protein diet. Lower crude protein diets can be fed successfully without negatively impacting performance or carcass quality.

Introduction

There is increasing interest in formulating diets with lower crude protein content. The declining cost of synthetic amino acids, a desire to minimize the nitrogen content in the slurry and an interest in reducing greenhouse gases all contribute to this interest. However, in the past, low crude protein diets sometimes reduced growth performance and often resulted in fatter carcasses.

Experimental Procedures

This experiment employed three dietary treatments (Table 1). The control diet was formulated to contain a level of crude protein that required no more than 0.1% L-Lysine HCl to meet the pig's requirement for lysine, i.e. a typical diet used by the pork industry today. The low protein diet was formulated with the lowest possible crude protein level without using any synthetic L-tryptophan. In other words, levels of L-lysine HCl, DL-methionine and L-threonine were allowed to float in order to meet the pig's requirement for these three essential amino acids. However, synthetic L-tryptophan was not included in the formulation. This resulted in diets that contained as much as 3.5 kg L-lysine HCl, 1.4 kg L-threonine and 40 g DL-methionine per tonne of complete feed. These levels are clearly well above current commercial practice. A third diet was formulated to be intermediate in crude protein level between the other two. Diets were formulated to maintain a constant NE:Lysine ratio and equal levels of minerals and vitamins. Dietary electrolyte balance was similar across treatments.

There were a total of five pens and 110 pigs per treatment for a total of 660 pigs (330 gilts and 330 barrows). All pigs were housed in fully slatted concrete floored pens measuring 5.8 X 2.4 m. with spindle penning dividers. Pigs were housed 22 to a pen, providing 0.65 m^2/pig. Pigs were on test from 30 kg to 115 kg.

Results and Discussion

Overall, performance was excellent, with growth rates averaging 959 g/d. Feed conversion was also a very good 0.359, or 2.79:1. The uniformity of performance was also very good, with the SEM for daily gain only 8 g/d and for feed intake only 25 g/d.

There were no significant effects of crude protein on average daily gain, average daily feed or feed efficiency (P>0.10). However, there was a significant interaction between treatment and days on test (P<0.05).

Reducing crude protein had no negative effects on carcass quality; surprisingly, the lowest crude protein diet resulted in the thickest loin (P<0.05). Premiums were higher on the low protein diet (Table 3) as was the returns over feed cost. The feed cost considers the cost of the diet and days on test, which increased as dietary crude protein decreased. As expected,

Table 1. Composition of the experimental diets[1]

	Treatment					
	High		Medium		Low	
	Male	Female	Male	Female	Male	Female
	35 – 60 kg					
Wheat	43.990		47.672		51.365	
Soybean meal HP	26.144		22.510		18.870	
Barley	25.000		25.000		25.000	
L-Lysine•HCl	0.090		0.178		0.265	
L-threonine	--		0.037		0.074	
DL-Methionine	--		0.011		0.021	
	60 – 90 kg					
Wheat	52.021	46.993	55.254	52.755	58.490	58.521
Soybean meal	HP18.199	22.593	14.761	16.904	11.322	11.214
Barley	26.000	26.000	26.000	26.000	26.000	26.000
L-Lysine•HCl	0.098	0.039	0.192	0.193	0.286	0.347
L-threonine	--	--	0.068	0.066	0.136	0.132
DL-Methionine	--	--	0.015	0.020	0.029	0.040
	90 – 115 kg					
Wheat	21.282	29.875	26.011	34.158	30.743	38.446
Soybean meal	HP14.620	15.720	10.066	11.385	5.512	7.049
Barley	60.000	50.000	60.000	50.000	60.000	50.000
L-Lysine•HCl	0.080	0.108	0.203	0.226	0.325	0.343
L-threnine	--	--	0.045	0.051	0.089	0.101
DL-Methionine	--	--	0.005	0.016	0.009	0.032

[1] Diets also contained canola oil, dicalcium phosphate, limestone, vitamin and mineral premix, salt and sodium bicarbonate. Net energy, net energy:lysine ratio, minerals and vitamins were constant across treatments.

[1] Ajinomoto Heartland Inc., Chicago IL, USA.

gilts indexed higher than barrows (111.9 vs. 109.7), with higher lean yield (60.4% vs 59.2%), less backfat (19.1 mm vs 21.4 mm), a thicker loin (61.6 mm vs 59.0 mm), a wider backfat:loin spread(42.5 mm vs 37.6 mm) and earning higher quality premiums ($4.83 vs $4.07). These gender effects are all within the expected range. The thicker loin on the low protein diet was unexpected and needs to be repeated to see if this effect is real.

Detailed results of this experiment can be obtained by requesting Monograph No. 02-03 from the Prairie Swine Centre.

Implications

When diets are formulated on a net energy basis, synthetic amino acids used judiciously, and dietary electrolyte balance is maintained reasonably constant, crude protein levels can be reduced and performance maintained. Indeed, as evidenced by the thicker loin eye on the low protein diet, carcass quality may be improved.

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Table 2. Effects of protein level on pig performance.

	TREATMENT									
	Male			***Female***				***P-values***		
	High	Medium	Low	High	Medium	Low	SEM	Gender	Trt	Gender *Trt
Phase I (30-60 kg)										
Ave. Daily Gain, kg.	0.94	0.92	0.96	0.93	0.91	0.91	0.01	0.14	0.44	0.41
Ave. Daily Feed, kg.	2.05	2.01	2.10	2.03	1.97	2.03	0.02	0.12	0.10	0.75
Gain:Feed	0.46	0.46	0.46	0.46	0.46	0.45	0.004	0.96	0.9	0.66
Phase II (60-90 kg)										
Ave. Daily Gain, kg.	0.95	0.95	0.96	0.93	0.92	0.93	0.01	0.10	0.74	0.98
Ave. Daily Feed, kg.	2.87	2.81	2.92	2.75	2.56	2.62	0.03	<0.001	0.09	0.18
Gain:Feed	0.33	0.34	0.33	0.34	0.36	0.36	0.004	<0.001	0.07	0.17
Phase III										
Ave. Daily Gain, kg.	1.04	1.06	1.03	1.02	1.02	1.02	0.02	0.56	0.93	0.93
Ave. Daily Feed, kg.	3.65	3.54	3.58	3.17	3.24	3.26	0.06	<0.001	0.96	0.66
Gain:Feed	0.29	0.30	0.29	0.32	0.31	0.33	0.006	0.01	0.88	0.40

Table 3. Effects of protein level and gender on carcass parameters.

	TREATMENT									
	Male			***Female***				***P-values***		
	High	Medium	Low	High	Medium	Low	SEM	Gender	Trt	Gender *Trt
Settlement weight, kg	88.60	88.70	88.70	89.54	88.84	89.50	0.23	0.29	0.87	0.83
Index	109.4	109.4	110.2	112.0	112.2	111.6	0.2	<0.001	0.93	0.40
Lean yield, %	59.22	59.00	59.32	60.36	60.54	60.24	0.12	<0.001	0.99	0.30
Value, $	106.5	105.76	109.50	109.58	108.35	109.15	0.73	0.76	0.95	0.97
Fat, mm	21.2	21.7	21.4	19.1	18.4	19.7	0.2	<0.001	0.49	0.23
Lean, mm	58.1	58.6	60.4	61.6	60.0	63.1	0.2	<0.001	0.01	0.31
Spread, mm	36.9	37.0	39.0	42.5	41.7	43.3	0.3	<0.001	0.20	0.81
Price, $	1.10	1.084	1.117	1.091	1.084	1.09	0.07	0.82	0.96	0.97
Premium, $	4.10	3.95	4.17	4.74	4.76	5.00	0.13	<0.001	0.61	0.91
Total carcass value, $	110.6	109.71	113.67	114.32	113.11	114.15				
Total feed cost[1]	51.83	50.56	51.24	49.54	48.20	47.04				
Return/feed costs	2.13	2.17	2.22	2.31	2.35	2.43				

[1]Based on February, 2003 prices.