Ractopamine, at 5 or 10 mg /kg, increases protein deposition in the carcass

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SUMMARY

A comparative slaughter experiment utilizing 120 barrows was conducted to measure growth performance and nutrient retention in the carcass when either 0, 5 or 10 mg/kg ractopamine hydrochloride was added to the diet at 3 levels of dietary lysine. Therefore, there were 9 different dietary treatments (3 ractopamine x 3 lysine:DE ratios). Growth performance and nutrient retention in the carcass were determined. Ractopamine did not affect ADG, ADFI or the gain to feed ratio (P>0.10). With increasing lysine G:F improved (0.35, 0.35 and 0.39; P<0.05), ADG and ADFI were unaffected (P>0.10). Protein deposition rates tended to increase (162.1, 185.4 and 189.2 g/d with 0, 5 and 10 mg/kg ractopamine; P<0.11) and lipid deposition rates tended to decrease (619.8, 461.6, and 542.3 g/d) with 0, 5 and 10 mg/kg ractopamine, respectively, (P<0.10).

"Inclusion of 5 mg/kg ractopamine hydrocholoride improved protein deposition"

INTRODUCTION

Ractopamine hydrochloride, (RAC) is a ß-adrenergic agonist that belongs to the class of chemicals that includes, for example, clembuterol. Ractopamine hydrochloride is the active ingredient in Paylean®, widely used in the swine industry due to benefits such as increased growth rate, feed efficiency and carcass lean deposition. We (Patience et al. 2006 PSCI Annual Report) have shown improvements in growth performance and carcass quality when RAC was included in the diet at 5 mg/kg. The following experiment is part of a larger series of experiments examining the potential to utilize Paylean as a tool to reduce the environmental impact of pork production. We hypothesized that including Paylean in the diet would improve N retention, thus decrease N output in the urine and faeces of finishing swine. The specific objective in the experiment reported herein was to examine the effect of Paylean, added to the diet to supply 5 or 10 mg/kg RAC, on carcass nutrient deposition.

MATERIALS AND METHODS

A growth experiment was conducted which compared 9 different treatments. These included Paylean added to the diet to supply 0, 5 or 10 g/tonne RAC x 3 levels of dietary lysine (1.75 g/Mcal, 2.25 g/Mcal) and 2.75 g standardized ileal digestible lysine/Mcal DE. Additionally, because we know that the efficacy of Paylean reaches an optimum and then decreases, we included two slaughter weights as an additional factor.

Diets were based on wheat, barley, and soybean meal and also contained canola oil, vitamin/mineral premix, synthetic amino acids and Paylean. All diets were formulated to contain 3,300 kcal DE/kg) and formulated to meet or exceed the nutrient requirements of the finisher pig (NRC, 1998).

The experiment began when the barrows reached 95 ± 3 kg bodyweight and ended when they reached a final weight of either of 108 or 120 ± 3 kg. Pigs were euthanized by captive bolt stunning, followed by exsanguination; all blood was collected and returned to the carcass. The carcass was split down the midline from the groin to the chest cavity and the entire gastrointestinal tract (GIT) was removed, emptied of digesta and patted dry. The gall and urinary bladders were also drained of contents. The emptied GIT was then returned to the carcass and an empty body weight recorded. Carcasses were ground, freeze-dried and subsequently analyzed for moisture, N, fat and ash (indicative of total mineral content).

RESULTS AND DISCUSSION

Paylean had no effect on ADG, ADFI or G:F (Table 2; P > 0.10). Lysine had no effect on ADG or ADFI (P>0.10). However, G:F increased with high dietary lysine concentration (P<0.05). ADFI was higher in the 120 kg slaughter weight treatment (P<0.05) when compared to the 108 kg slaughter weight. Slaughter weight did not affect ADG or G:F (P>0.05).

Paylean tended to increase protein deposition in the carcass (25 g/d increase, 0 vs 10 mg/kg RAC; P<0.12; Table 3), increased water deposition rate (P<0.05), and tended to reduce fat deposition rate (P<0.10; Table 3). The lowest fat deposition was observed with the 5 mg/kg RAC level (620, 462, and 542 g/d fat deposition for 0, 5 and 10 mg RAC/kg feed). Protein, but not fat deposition rate increased in response to lysine (P<0.05). The 120 kg slaughter weight pigs had increased deposition rates of protein, fat and water (P<0.05) compared to the barrows slaughtered at 108 kg however, there was no RAC by slaughter weight interaction (P>0.10).

The lack of a growth response to Paylean in this experiment is contrary to the preponderance of previous research. The response to Paylean diminishes after it has been fed for about 28 days. The average time on Paylean in these experiments was 17 and 9 days for the 120 and 108 kg slaughter groups, respectively, therefore a growth response was expected.

A response to increasing dietary lysine : DE ratio was observed. Pigs received 18.9, 23.6 and 25.8 g SID lysine per day which exceeds NRC (1998) lysine requirements. However, present day pigs may require more lysine than the NRC (1998) recommendations. Additionally, because of the improvement in lean growth with Paylean, the finishing pig's requirement for lysine increases when Paylean is added to the diet. However, if lysine was limiting the response to Paylean we would expect to see a lysine by Paylean interaction due to a greater response to Paylean at the higher lysine levels. This, however, was not observed (Table 2).

Table 1. Ingredient composition of experimental diets (% as fed)[1]

SID Lys (g/Mcal DE)	1.75	2.25	2.75
Ingredient, %			
Wheat	59.27	54.52	47.93
Barley	30.00	31.00	32.00
Soybean Meal	6.40	10.00	15.50
Limestone	0.750	0.750	0.750
Dicalcium Phosphate	0.550	0.500	0.450
Salt	0.500	0.500	0.500
PSC Mineral Premix [2]	0.500	0.500	0.500
PSC Vitamin Premix [3]	0.500	0.500	0.500
Lysine HCL	0.135	0.250	0.310
dL-Methionine	-	0.010	0.050
L-Threonine	-	0.070	0.115
Canola Oil	1.000	1.000	1.000
Celite [4]	0.400	0.400	0.400
Paylean [3]	0.000	0.000	0.000
Formulated Analysis			
DE, kcal/kg	3,300	3,300	3,300
Crude Protein, %	16	17	19
Total Lysine, %	0.650	0.840	1.030
SID Lysine, %	0.580	0.750	0.850

1 Each of these diets was fed with either 0, 5 or 10 mg/kg RAC added to provide 9 different treatments.
2.Provided per kg of diet: zinc, 100 mg as zinc sulphate; iron, 80 mg as ferrous sulphate; copper, 50 mg as copper sulphate; manganese, 25 mg as manganous sulphate; iodine, 0.50 mg as calcium iodate; selenium, 0.10 mg as sodium selenite.
3 Provided per kg of diet: Vitamin A, 8250 IU; Vitamin D, 825 IU; Vitamin E, 40 IU; niacin, 35 mg; D-pantothenic acid, 15 mg; menadione, 4 mg; folacin, 2mg; thiamine, 1 mg; D-biotin, 0.2 mg; Vitamin B12, 25 ug.
4.Included as a marker for digestibility measurements.

Table 3. The effect of Paylean (RAC), lysine and slaughter weight on carcass nutrient deposition rates in finishing barrows

Item	Protein	Fat	Ash	Water
RAC (ppm)		g/d		ml/d
0	162.1	619.8	26.3	466.3
5	185.4	461.6	25.2	608.7
10	189.2	542.3	27.1	572.5
Lysine (g/Mcal)				
1.75	160.0	574.2	24.1	479.0
2.25	178.8	553.3	28.7	548.9
2.75	198.0	496.2	25.8	619.7
SEM[3]	*10.77*	*49.68*	*2.18*	*45.80*
Slaughter Weight (kg)				
108	166.1	600.1	24.2	476.7
120	191.7	482.4	28.3	621.7
SEM	*9.20*	*42.22*	*1.78*	*38.97*

Statistics	P-value			
Paylean	0.111	0.055	0.837	0.050
Lysine	0.027	0.461	0.329	0.066
Paylean x Lysine	0.786	0.754	0.338	0.726
Slaughter Weight	0.027	0.029	0.109	0.004

It is interesting that even though we didn't observe a growth response to Paylean we did see an increase in protein and water and a decrease in lipid deposition when Paylean was added to the diet. Overall, this would be expected to result in a leaner carcass. Moreover, the rate of protein deposition (g/d) was higher for the pigs slaughtered at 120 than at 108 kg ($P<0.05$). The opposite was seen with lipid deposition ($P<0.05$). Lean tissue is approximately 80% water, while adipose tissue contains only about 15% water, thus we expect increased water deposition to accompany the higher protein deposition. It should be noted that the baseline protein deposition rates in these pigs was high. This can be attributed to a multitude of factors including genetics, diet, environment or due to the slaughter process used in this experiment (entire carcass was ground). Regardless, even at the 5 mg/kg level, RAC improved protein deposition above the baseline.

IMPLICATIONS

Although there was no response in growth rate, 5 mg/kg RAC improved protein deposition. The response to RAC may not be evident if growth rate is the only criteria measured. Lysine requirements may be higher than recommended when Paylean is used in a herd with high rate of protein deposition.

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Table 2. Effect of Paylean, lysine, and slaughter weight on growth rate, feed intake and feed conversion in finishing barrows[1]

Item	Initial Body Weight, kg	ADG kg/d	ADFI, kg/d	G:F, kg/kg
RAC (ppm)				
0	96.5	1.4	4.0	0.35
5	95.9	1.4	3.9	0.36
10	96.0	1.5	3.8	0.38
Lysine (g/Mcal)				
1.75	95.9	1.4	4.0	0.35
2.25	96.3	1.4	3.9	0.35
2.75	96.3	1.5	3.9	0.39
SEM[2]	*0.56*	*0.06*	*0.11*	*0.01*
Slaughter Weight (kg)				
108	95.9	1.4	3.8	0.37
120	96.4	1.5	4.0	0.36
SEM	*0.52*	*0.05*	*0.10*	*0.01*

Statistics		P-value		
RAC	-[2]	0.775	0.277	0.164
Lysine	-	0.232	0.783	0.029
RAC x Lysine		0.636	0.108	0.756
Slaughter Weight		0.307	0.009	0.636

1 Data expressed as least square means. Data analyzed with initial body weight as a covariate.
2 (–) indicates no statistics were calculated on that parameter