2011

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Barrows fed ractopamine during the finishing phase require 0.76% total lysine in order to maximize growth performance.

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Summary

A total of 36 individually penned barrows (initial weight = 176 lb) were used in an experiment conducted to determine the lysine requirement for barrows fed ractopamine during the last 85 lb of the finishing phase. There were six dietary treatments that were corn-soybean meal-based with additional crystalline amino acid supplementation. Pigs were assigned to one of six dietary treatments for the duration of the experiment. Treatments included lysine concentrations ranging from 0.5 to 1.3% total lysine. Dietary treatment significantly affected average daily gain and feed efficiency. The total lysine requirement was estimated to be 0.76%. These results indicate that the outcome of ractopamine utilization can be influenced by amino acid concentration of the diet in the finishing phase.

Introduction

Ractopamine is currently used in the commercial swine industry to increase growth performance during late finishing. It is stated by the current manufacturer of ractopamine (Elanco) that the dietary crude protein concentration of the diet should be $\geq$ 16%. However, there is limited information available concerning the amino acid requirements for pigs fed diets containing ractopamine. In order to maximize performance during the finishing phase of production, it is important to better understand specific amino acid requirements. An improved understanding of amino acid nutrition as it pertains to ractopamine use can allow for optimal pig performance. The objective of this experiment was to determine the lysine requirement for barrows fed ractopamine during the last finisher phase.

Procedures

Animals and Facilities

Animal use and procedures for the experiment were approved by the Intitutional Animal Care and Use Committee of the University of Nebraska–Lincoln. A total of 36 crossbred barrows (initial BW = 176 lb) were individually penned in an

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environmentally controlled room. Automatic waterers and feeders were located in each pen. Pigs were allowed ad libitum access to feed and water throughout the entire experiment.

Dietary Treatments

Each pig was randomly assigned to one of six dietary treatments. The six isocaloric dietary treatments included: a control diet without ractopamine (RAC) formulated to contain 0.7% total lysine; the control diet with the inclusion of 10 ppm RAC and 0.7% total lysine; and four additional diets with 10 ppm RAC and differing concentrations of total lysine for a total of six dietary treatments (0.5, 0.9, 1.1, and 1.3% total lysine, respectively). All dietary treatments were corn-soybean meal-based. Other amino acids were maintained at a concentration at least +10% of the true ileal digestible amino acid to lysine ratios suggested by NRC (1998; Table 1).

Data Collection

Pigs and feeders were weighed at the beginning and end of each week. Data collected included feed disappearance and weight gain in order to calculate average daily feed intake (ADFI), average daily gain (ADG), and feed efficiency (G:F). Ultrasound measurements were taken weekly to determine backfat thickness (BF) and longissimus muscle area (LMA).

Statistical Analysis

Data were analyzed as a completely randomized design using the MIXED procedure (SAS Inst. Inc. Cary, N.C.). Each animal was considered the experimental unit. To determine the optimal concentration of total lysine in the diet, broken line, nonlinear regression was used.

Results and Discussion

The growth performance results of the barrows are shown in Table 2. Dietary lysine concentration affected ADG ($P < 0.05$). The lowest ADG

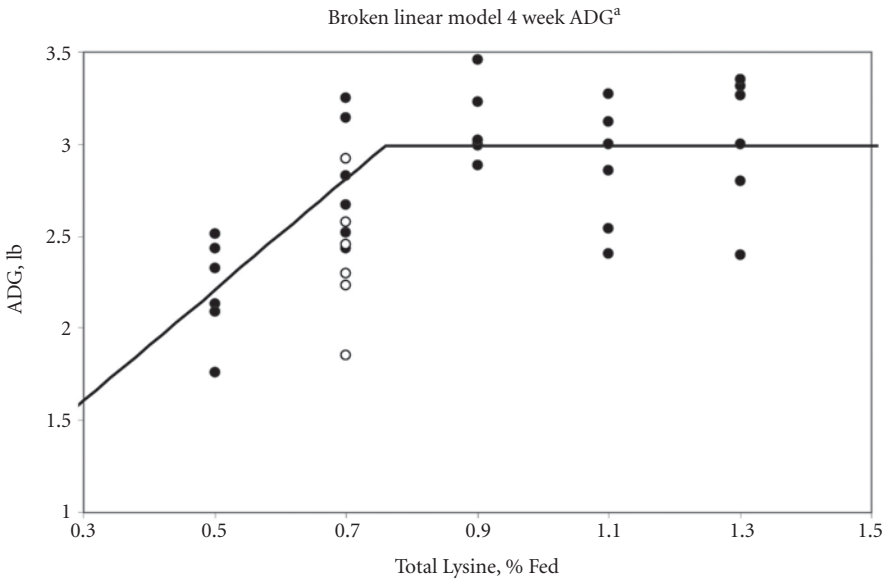

Figure 1. Observed and predicted values from four-week response data ($R^2 = 0.515$). [a]ADG = average daily gain. Black dot (●) represents ADG response for pigs fed diets containing 10 ppm ractopamine at varied total lysine %. White dot (○) represents ADG response for pigs fed diets without ractopamine and 0.7% total lysine. Solid line (—) represents predicted ADG response for pigs fed 10 ppm ractopamine at varied total lysine %. Prediction equation: If total lysine % < 0.76 then ADG = 2.99 + (−3.01 × (0.76 − total lysine %); If total lysine % ≥ 0.76 then ADG = 2.99.

Table 1. Ingredients and calculated composition of the dietary treatments for Experiment 1, as-fed basis.

	Diet					
Total Lysine, %	0.7	0.5	0.7	0.9	1.1	1.3
Ingredient, %	No RAC[a]					
Corn	85.06	91.40	85.06	78.67	72.26	65.81
Soybean meal-47.5% CP[b]	12.83	6.50	12.83	19.17	25.50	31.84
Biolys®[c]	0.18	0.13	0.18	0.23	0.28	0.33
L-threonine	0.03	0.00	0.03	0.08	0.12	0.17
DL-methionine	0.00	0.00	0.00	0.01	0.07	0.14
L-tryptophan	0.01	0.01	0.01	0.02	0.02	0.03
Dicalcium phosphate	0.52	0.56	0.52	0.48	0.44	0.39
Limestone	0.74	0.77	0.74	0.71	0.68	0.66
NaCl	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin premix[d]	0.20	0.20	0.20	0.20	0.20	0.20
Trace mineral premix[e]	0.15	0.15	0.15	0.15	0.15	0.15
Antibiotic[f]	0.03	0.03	0.03	0.03	0.03	0.03
RAC, ppm	0.00	10.00	10.00	10.00	10.00	10.00
Calculated composition						
Lysine, %	0.70	0.50	0.70	0.90	1.10	1.30
CP, %	13.33	10.78	13.33	15.91	18.46	21.04
Calcium, %	0.45	0.45	0.45	0.45	0.45	0.45
Available phosphorus, %	0.15	0.15	0.15	0.15	0.15	0.15
ME[g], Mcal[h]/lb	1.52	1.52	1.52	1.52	1.52	1.52
True digestible AA[i]:Lys[j]						
Threonine	71.69	75.34	71.69	72.21	71.52	71.90
Met + Cys[k]	76.45	96.19	76.45	67.08	66.27	66.55
Tryptophan	20.92	22.01	20.92	21.57	20.97	21.41

[a]RAC = Ractopamine.
[b]CP = Crude protein.
[c]Biolys®, Evonik-Degussa Feed Additives (Kennesaw, Ga.).
[d]Supplied per kilogram of diet at 0.2% inclusion: vitamin A as retinyl acetate, 4,400 IU; cholecalciferol, 440 IU; α-tocopherol acetate, 24 IU; menadione sodium bisulfite, 3.5 mg; riboflavin 8.8 mg; d-pantothenic acid, 17.6 mg; niacin, 26.4 mg; vitamin B_{12}, 26.4 mg.
[e]Supplied per kilogram of diet at 0.15% inclusion: Zn (as $ZnSO_4$), 128 mg; Fe (as $FeSO_4 \bullet H_2O$), 128 mg; Mn (as MnO), 30 mg; Cu ($CuSO_4 \bullet 5\ H_2O$), 10.5 mg; I (as $Ca(IO_3) \bullet H_2O$), 0.26 mg; Se (as Na_2SeO_3), 0.26 mg.
[f]Tylan®, Elanco Animal Health (Greenfield, Ind.).
[g]ME = Metabolizable energy.
[h]Mcal = megacalories.
[i]AA = amino acid.
[j]Lys = lysine.
[k]Met + Cys = methionine plus cysteine.

Table 2. Repeated measure data for overall performance (4 weeks).

	Treatment										
Lysine, %	0.7	0.5	0.7	0.9	1.1	1.3		*P* values			
RAC[a], ppm	0	10	10	10	10	10	SEM[b]	TRT[c]	Wk[d]	T x W[e]	RAC
4 week											
ADG[f], lb	2.46	2.20	2.82	3.10	2.86	3.01	0.132	< 0.01	< 0.01	0.10	0.08
ADFI[g], lb	7.06	7.39	7.46	7.85	7.04	7.04	0.326	0.51	< 0.01	0.32	0.38
G:F[h], lb/lb	0.35	0.29	0.38	0.40	0.41	0.42	0.016	< 0.01	< 0.01	0.07	0.19
BFwg[i], in	0.06	0.07	0.07	0.10	0.06	0.06	0.012	0.23	< 0.01	0.47	0.49
LMAwg[j], in^2	0.36	0.26	0.34	0.47	0.40	0.41	0.070	0.45	< 0.01	0.25	0.84

[a]RAC = ractopamine.
[b]SEM = standard error of the mean.
[c]TRT = treatment.
[d]Wk = week.
[e]T x W = treatment by week interaction.
[f]ADG = average daily gain.
[g]ADFI = average daily feed intake.
[h]G:F = gain to feed ratio.
[i]BFwg = weekly gain in backfat thickness.
[j]LMAwg =weekly gain in longissimus muscle area.

Table 3. Broken line analysis for optimal total lysine concentration.

	Maximum response[a]	Requirement[b]	Upper 95%[c]	Sum of (residual^2)	R^2
4 week					
ADG[d]	2.99	0.76	0.89	0.535	51.5
G:F[e]	0.40	0.77	0.88	0.027	65.0

[a]Maximum response = the maximum response expected.
[b]Requirement = amount of total lysine, %, required in order to achieve the maximum response.
[c]Upper 95% = requirement plus 2 standard deviations of the mean requirement.
[d]ADG = average daily gain, lb.
[e]G:F = gain to feed ratio, lb/lb.

response was observed in pigs fed the diet containing the lowest amount of total lysine. There was a tendency for increased ($P < 0.08$) ADG of pigs fed 0.7% total lysine with ractopamine compared to pigs fed 0.7% total lysine without ractopamine. There were no significant differences detected for ADFI during the 4-week period ($P > 0.10$). Dietary treatment also had an effect on G:F ($P < 0.05$). Again, the lowest G:F was observed for pigs fed 0.5% total lysine. There was no significant effect of treatment on BF or LMA change during the experimental period ($P > 0.10$).

The four-week overall broken line regression data indicate that 0.76% total lysine was adequate in order for barrows to maximize ADG (Table 3). The results for G:F indicate a slightly greater requirement of 0.77% total lysine in order to maximize efficiency. It is important to note that requirements can be affected by several factors, including genetics and environmental conditions. The results of this experiment indicate that lysine concentration of the diet can affect the performance of pigs fed ractopamine. For barrows of the genetic background used, housed in experimental conditions, the broken-line regression results indicate that 0.76% total lysine is adequate for optimal growth performance.

Conclusions

Overall, dietary lysine concentration had significant effects on ADG and G:F. This indicates that total lysine concentration can play an important role in determining the amount of increased performance when feeding ractopamine. A total lysine concentration of 0.76% is adequate for obtaining maximal growth for barrows fed ractopamine. Further research is planned investigating the requirements of other amino acids when feeding ractopamine to finishing pigs.

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