Lysine Requirements of PIC Barrows during Growing-Finishing Period

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ASL–R653

Summary and Implications

True digestible lysine requirements of PIC barrows were estimated by using a PUN (plasma urea nitrogen) technique. For the individually penned barrows, daily true digestible lysine requirements were 16.5, 17.8, 19.9, 20.2, 17.4, 16.7, 16.9, and 14.4 grams at the body weights of 33, 52, 69, 72, 87, 93, 106, and 113 kg, respectively. Based on the results, a lysine requirement model of the pigs over the growing and finishing period under an individually penned environment was established. The equation was $y = 0.000001x^4 - 0.0004x^3 + 0.0365x^2 - 1.329x + 32.691$, in which y is the true digestible lysine requirement in grams /day, and x is the body weight in kilograms. True digest lysine requirements of the pigs under a group-penned environment were determined to be 15.8 and 19.1 g/d, at 32 and 50 kg body weight, respectively.

Introduction

For growing-finishing pigs, providing optimum dietary lysine is crucial for maximum lean growth and minimum feed cost . The adequacy of dietary lysine can be detected by plasma urea nitrogen (PUN), which transports excessive nitrogen to kidney for excretion. When pigs are administrated with a series of diets of different lysine concentrations from deficient to excessive, PUN is expected to decrease until the lysine requirement is met. By fitting PUN responses to dietary lysine concentrations into a two-slope, broken-line regression model, a break-point can be found where PUN reaches its lowest level, and the lysine concentration corresponding to that point is the lysine requirement. Lysine requirement changes as pigs grow and is affected by factors such as genetics, sex, and environments. The objective of our research was to estimate lysine requirements of PIC barrows at approximately 30, 50, 70, 90, and 110 kg of body weight, and to establish a model to calculate lysine requirements over the growing-finishing period. Producers of PIC barrows can use the calculated lysine requirement form the model as a reference in deciding dietary lysine concentration for their pigs, making appropriate adjustments based on factors such as temperature, pen-situation, and feed intake.

Materials and Methods

Two series of experiments were conducted to determine lysine requirements of the barrows under an individually penned environment. In the first experiment, 20 PIC barrows with an average initial body weight of 19.1 kg and an average final body weight of 115.4 kg were used. The animals were randomly allotted to pens based on body weight and each pen was considered as the experiment unit. The pens were .6 × 2.2 meter individual-feeding pens with steel slatted flooring, each containing a stainless steel self-feeder and a nipple drinker. The room was well ventilated and the temperature was controlled to be at the range of 18 to 30°C. In this series, lysine requirements of the pigs were estimated at approximately 33, 52, 72, 93, and 113 kg body weight .

In the second series, another group of 20 PIC barrows with an average initial body weight of 45.2 kg and final body weight of 114.8 kg was used to determine lysine requirements at approximately 69, 87, and 106 kg body weight under an individually penned environment. The room temperature was controlled to be between 17 and 24°C.

The third series of experiments was designed to determine lysine requirements at approximately 30 and 50 kg body weight under a group-penned environment. To accomplish this, 100 PIC barrows with an average initial body weight of 24.4 kg were used. The average final body weight was 53 kg. The pigs were arranged in four blocks based on litter, initial body and pen location. The five dietary treatments were allotted randomly to the pens within each block. There were five pigs per pen and each pen was considered as an experimental unit. The pens were 1.8 × 2.6 meter group-feeding pens with partially slatted concrete floors, each containing a two compartment stainless steel self-feeder and a nipple drinker. The room was well ventilated and the temperature ranged between 11 and 31°C.

For each experiment, the dietary treatments were five levels of true digestible lysine ranging from deficient to excess, with the third level near the requirement predicted by the NRC(1998) model at the specified body weight and from an average lean growth rate of 350 grams per day. Corn, wheat, and soybean meal (series 1 and series 3) or corn and soybean meal (series 2) were used to formulate the basal diets containing the lowest lysine levels, and the other four dietary lysine levels were achieved by supplementation with crystalline lysine·HCl. All other essential amino acids were at or above their optimal ratios to the highest lysine concentration and they remained at the same concentrations in the five dietary treatments. Diets were formulated to have identical electrolyte balance (Na + K – Cl) by replacing sodium chloride with sodium carbonate, in accordance with the amount of lysine·HCl supplementation. All diets were made isonitrogenous by using L-glutamic acid supplementation. Blood samples were taken from the pigs during the dietary treatment periods and the plasma samples were used for PUN analysis.

Results and Discussion

PUN responses to dietary lysine concentrations are presented in Tables 1 - 3. The daily true digestible lysine requirements are summarized in Table 4. For individually penned barrows, daily true digestible lysine requirements were 16.5, 17.8, 19.9, 20.2, 17.4, 16.7, 16.9, and 14.4 grams at the body weights of 33, 52, 69, 72, 87, 93, 106, and 113 kg, respectively. Over the growing-finishing period, lysine requirement increased as pigs grew from approximately 30 kg, achieved its maximum point at approximately 70 kg body weight, and decreased thereafter. The relationship between the lysine requirement and body weight could be expressed by the following equation: $y = 0.000001x^4 - 0.0004x^3 + 0.0365x^2 - 1.329x + 32.691$, in which y is the true digestible lysine requirement in grams per day, and x is the body weight in kilograms. Lysine requirements of PIC barrows under a group-penned environment were 15.8 and 19.1 grams per day at the body weights of 32 and 50 kg, respectively.

Compared with the individually-penned pigs, the group-penned barrows needed less lysine at approximately 30kg, but more lysine at approximately 50kg of body weight. The reason for this is not fully understood.

Table 1. PUN responses to dietary true digestible lysine % (series 1).

Body weight, kg	Item	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	CV,%	P-value[a]
33	Lysine, %	.732	.807	.882	.957	1.032		
	PUN,mg/dl	11.77	9.98	8.90	8.92	8.67	13.8	.04
52	Lysine, %	.527	.602	.677	.752	.827		
	PUN,mg/dl	10.37	9.96	8.71	8.30	8.56	11.3	.11
72	Lysine, %	.430	.510	.590	.670	.750		
	PUN,mg/dl	11.17	9.52	9.25	7.50	7.32	14.1	.005
93	Lysine, %	.354	.434	.514	.594	.674		
	PUN,mg/dl	11.33	9.94	9.74	8.49	8.90	13.1	.07
113	Lysine, %	.313	.393	.473	.553	.633		
	PUN,mg/dl	12.06	10.80	9.58	10.86	8.99	9.0	.005

[a] Probability of obtaining such differences if there is no effect of dietary lysine on PUN concentration.

Table 2. PUN responses to dietary true digestible lysine % (series 2).

Body weight, kg	Item	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	CV,%	P-value
69	Lysine, %	.500	.580	.660	.740	.820		
	PUN,mg/dl	9.73	8.56	6.75	5.55	4.88	14.2	.0001
87	Lysine, %	.350	.430	.510	.590	.670		
	PUN,mg/dl	9.19	7.49	6.17	5.13	4.06	13.3	.0001
106	Lysine, %	.330	.410	.490	.570	.650		
	PUN,mg/dl	10.35	9.51	7.73	6.20	5.73	14.6	.0001

[a] Probability of obtaining such differences if there is no effect of dietary lysine on PUN concentration.

Table 3. PUN responses to dietary true digestible lysine % (series 3).

Body weight, kg	Item	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	CV,%	P-value
32	Lysine, %	.723	.798	.873	.948	1.023		
	PUN,mg/dl	11.14	10.92	9.53	9.06	8.91	10.4	.05
50	Lysine, %	.577	.657	.737	.817	.897		
	PUN,mg/dl	11.59	11.64	10.44	8.25	9.09	18.0	.004

[a] Probability of obtaining such differences if there is no effect of dietary lysine on PUN concentration.

Table 4. True digestible lysine requirements of PIC barrows.

Environment	Body weight, kg	Requirement[b], g/d	R^{2c}
Individually penned			
	33	16.5 ± .2	.97
	52	17.8 ± .8	.97
	69	19.9 ± 2.7	.94
	72	20.2 ± 1.2	.99
	87	17.4 ± 2.0	.96
	93	16.7 ± .8	.99
	106	16.9 ± 1.5	.97
	113	14.4 ± 6.7	.99
Group-penned			
	32	15.8 ± 1.1	.97
	50	19.1 ± .9	.99

[b] values are means ± SEM for four pigs.
[c] R^2 for broken-line regression.