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Plasma Urea Can Be Used To Identify The Protein Requirements of Group-penned Finishing (130 to 220 lb) Barrows and Gilts Fed Corn-soybean Diets

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Summary and Implications

In this study, growth performance data from finishing pigs indicate the response of barrows and gilts to dietary protein concentration was maximized with a 15 percent protein corn-soybean meal diet. Review of the response of plasma urea concentration to dietary protein intake indicated that, in this study, the protein requirement of barrows was between 12 and 15 percent and the protein requirement for gilts was between 15 and 18 percent. Based on the many findings in the literature documenting that protein requirements (percent of the diet) of gilts are greater than those of barrows, we believe the use of plasma urea is an alternative approach to using growth performance data for establishing the protein (amino acid) requirements of finishing pigs. Identifying a small number of pigs for blood sampling may provide a less intensive method to help gain insight into the protein requirements of barrows and gilts during the finishing period. Future research will focus on refining the plasma urea technique to identify the response of barrows and gilts to dietary protein. Specifically, we are interested in pursuing the application of this methodology to commercial conditions.

Introduction

In the 1995 University of Nebraska Swine Report (pg. 42) we described a method to help determine the protein requirements of pigs with different genetic potentials for lean growth. We observed the response of plasma urea during the growing-finishing period was sensitive to changes in protein intake of pigs consuming corn-soybean meal diets. However, pigs used in the above experiment were housed individually and the two groups exhibited significantly different growth rates (a good research model, but limited applicability to the swine industry).

Therefore, the objective of the present study was to determine whether the profile of plasma urea concentration during the finishing period could be used to determine the response of group-penned finishing barrows and gilts to dietary protein concentration.

Procedures

One hundred twenty barrows and 120 gilts were used in a randomized complete-block experiment designed to investigate the use of plasma urea concentration as a method to identify protein requirements of group-penned finishing pigs. Pigs used in the experiment were considered to have a medium- to high-lean gain potential ((University of Nebraska White line x Duroc × Hampshire × Yorkshire × Danbred)×Danbred). Treatments were arranged in a 2× 4 factorial (two sexes and four diets). Each sex × diet combination was replicated three times.

Barrows and gilts (initial BW = 135 lb) were penned separately and each pen contained 10 pigs (5 ft^2/pig). Pigs were housed in a modified open-front building at the Swine Research Facility near Mead, NE. The duration of the experiment was 56 days and was

Table 1. Ingredient and analyzed composition of diets, as-fed basis

	Dietary protein concentration, %			
Ingredient, %	9	12	15	18
Corn	94.50	87.40	79.8	72.00
Soybean meal, 46.5% CP	2.75	10.00	17.75	25.70
Dicalcium phosphate	1.30	1.10	.90	.75
Limestone	.35	.40	.45	.45
Salt	.30	.30	.30	.30
Mineral premix	.10	.10	.10	.10
Vitamin premix	.70	.70	.70	.70
Analyzed composition, %				
Crude protein	9.31	12.31	14.86	17.94
Lysine	.29	.51	.64	.82
Calcium	.64	.64	.65	.64
Phosphorus	.51	.52	.53	.51

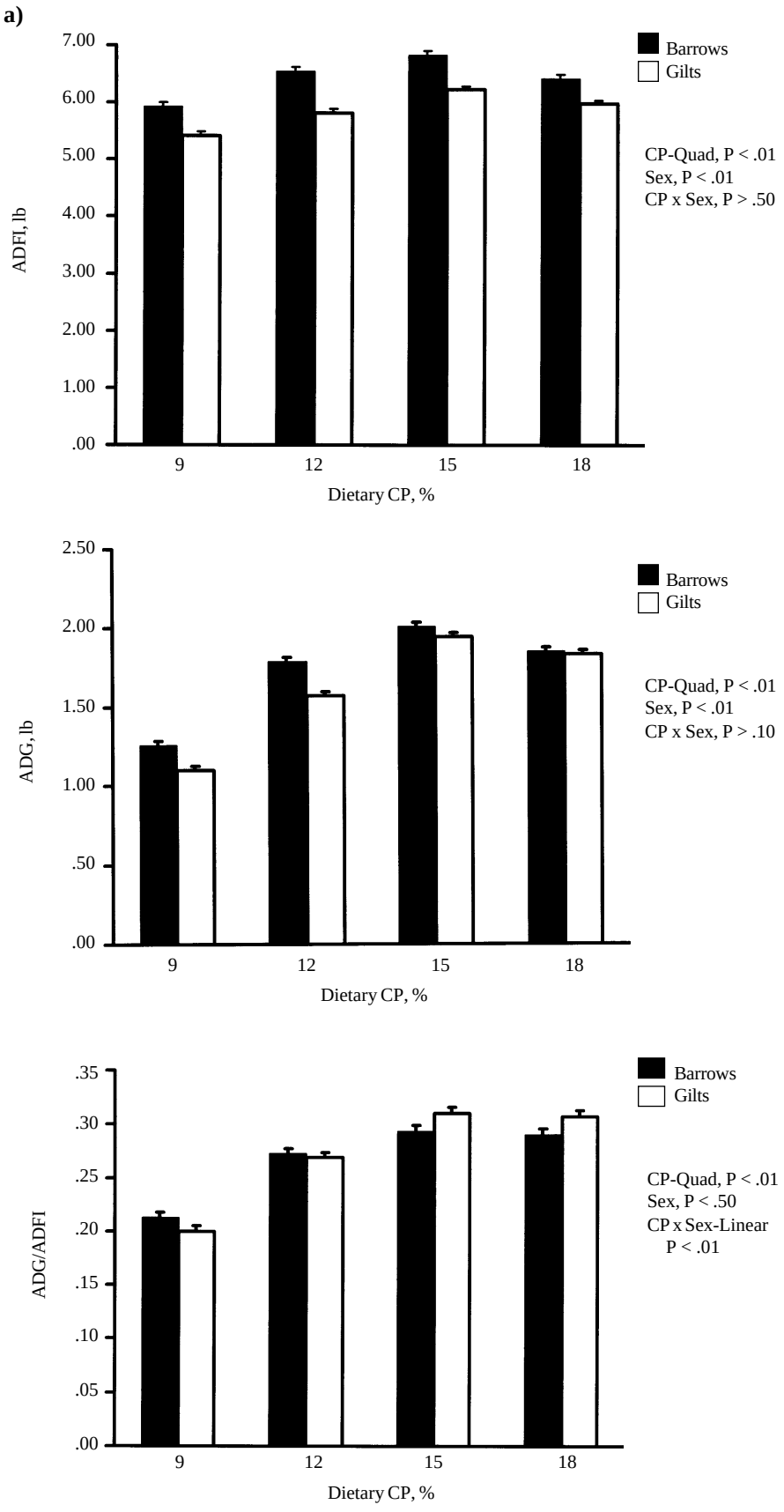

Figure 1. The response of a) average daily feed intake (ADFI), b) average daily gain (ADG), and c) feed efficiency (ADG/ADFI) to dietary protein concentration for barrows and gilts during the finishing period.

initiated in early August, 1996. Four corn-soybean meal-based diets formulated to contain 9, 12, 15 or 18 percent dietary protein (Table 1) were used. Each pen received the respective diet for the entire experiment. Pigs were weighed, feed disappearance determined and blood samples taken every seven days. Plasma was harvested and frozen until analyzed for urea content.

Growth performance data were analyzed as a randomized complete-block design with sex and dietary protein concentration as main effects. Orthogonal contrasts were developed to examine the pattern of growth performance responses to sex, protein concentration and the sex × protein concentration interaction.

Results and Discussion

Feed intake responded quadratically ($P < .01$) to dietary protein concentration (Figure 1a). Also, barrows consumed approximately 10 to 16 percent more ($P < .01$) feed than gilts. For both barrows and gilts, average daily feed intake was maximized in pigs consuming the 15 percent protein diet. The response of average daily gain to protein concentration (Figure 1b) was similar to that for average daily feed intake. Growth rate responded quadratically ($P < .01$) to dietary protein concentration and barrows consistently exhibited greater ($P < .01$) average daily gain than gilts. Again, the response of average daily gain was maximized in pigs consuming the 15 percent protein diet. Although feed efficiency responded quadratically ($P < .01$) to dietary protein concentration (Figure 1c, maximized in both barrows and gilts at 15 percent protein), no differences ($P > .50$) between barrows and gilts were observed. A protein concentration × sex interaction ($P < .01$) was observed for feed efficiency and can be attributed to the greater feed efficiencies for barrows compared to gilts below 15 percent protein and greater feed efficiencies for gilts compared to barrows at or above 15 percent dietary protein.

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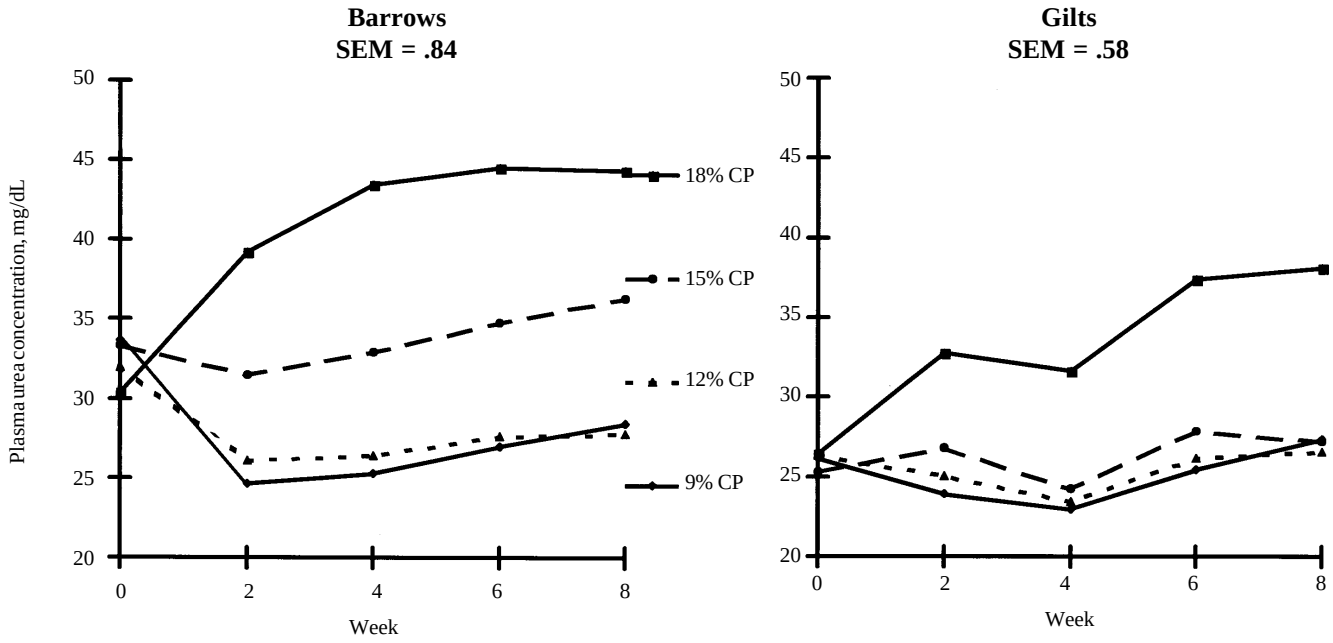

Figure 2. The response of plasma urea to dietary protein concentration for barrows and gilts during the 56-day finishing period.

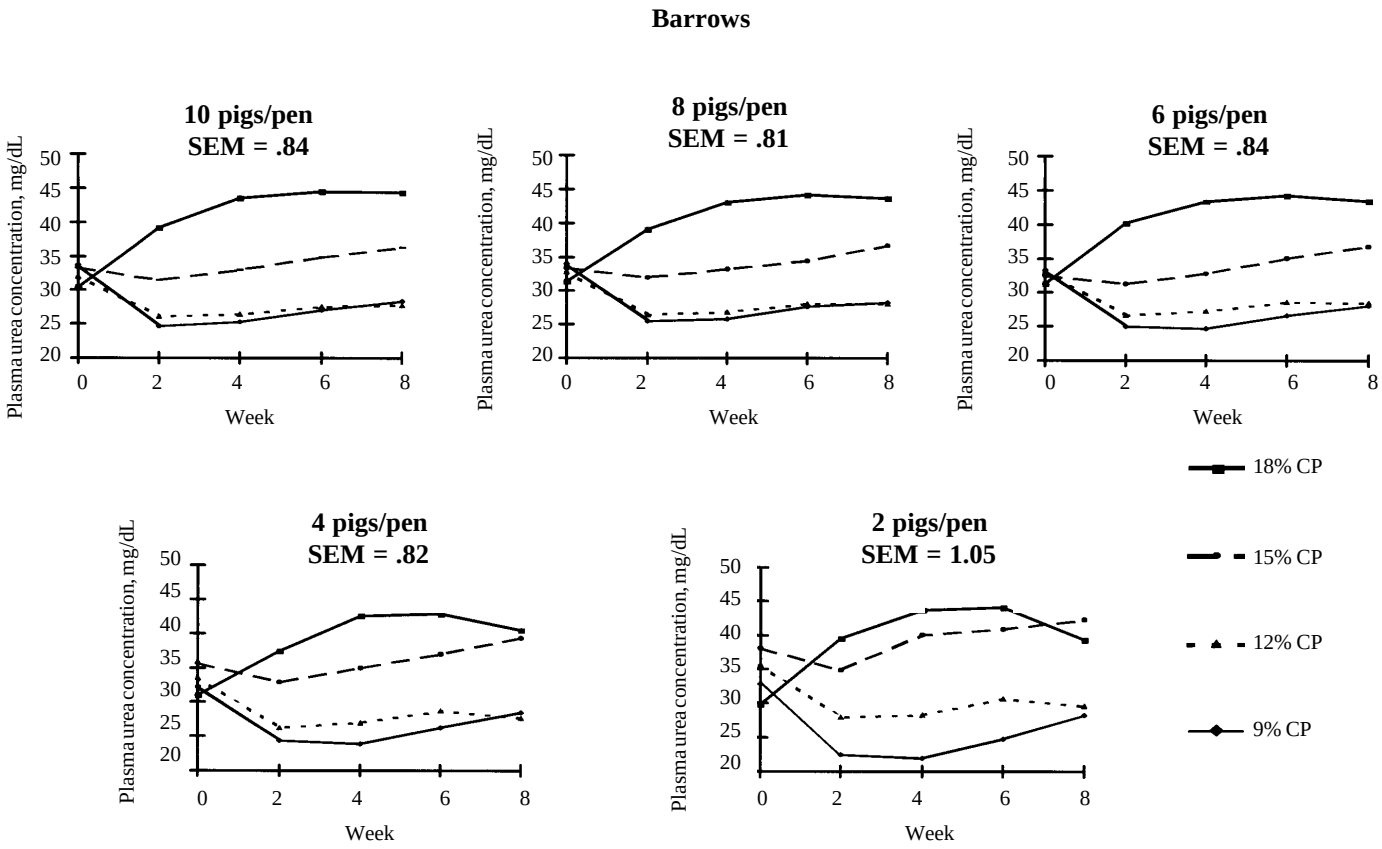

Figure 3. The response of plasma urea concentration to dietary protein concentration for barrows from data sets containing either 2, 4, 6, 8, or 10 pigs/pen.

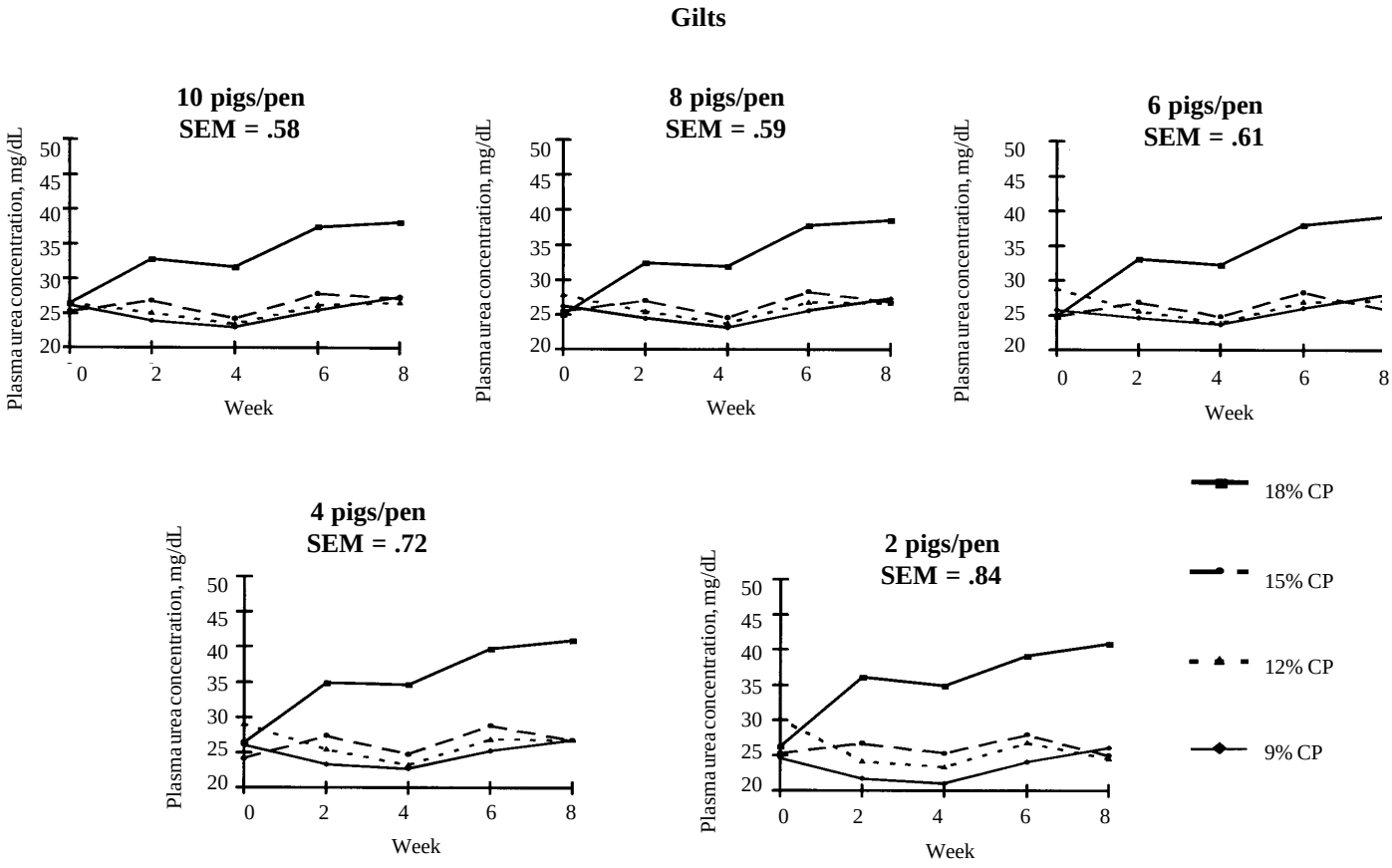

Figure 4. The response of plasma urea concentration to dietary protein concentration for gilts from data sets containing either 2, 4, 6, 8, or 10 pigs/pen.

Based on growth performance data, we determined the maximum response to dietary protein concentration to be 15 percent. Although barrows ate more feed and grew faster than gilts, these growth performance data do not indicate different protein requirements (percent of the diet) for barrows and gilts. Because of the relatively wide differences between protein levels, we may have been unable to determine the requirements if the differences between barrows and gilts had been one to two percent dietary protein.

The responses of plasma urea to dietary protein concentration during the 56-day experiment are presented in Figures 2, 3 and 4. An assumption we used to evaluate these plasma urea profiles: a minimum plasma urea concentration will be exhibited until the dietary protein requirement is achieved. Excess protein intake above the requirement will result in more urea (nitrogen) excretion and an increase in plasma urea concentration. Based on this model, Figure 2 suggests the threshold for dietary protein concentration for barrows was between 12 and 15 percent protein and that is was between 15 and 18 percent protein for gilts. Interestingly, the threshold plasma urea concentration was similar (~ 25 mg/dL) for barrows and gilts.

Because it would be desirable to take blood from just a few pigs rather than all the pigs in the pen (10 pigs in the present experiment) when acquiring blood samples for plasma urea analysis, we randomly selected data sets containing eight, six, four or two pigs/pen to see how many pigs are needed to accurately define the relationship between plasma urea concentration and dietary protein concentration (see Figures 3 and 4). For the barrows, the profile of the plasma urea response to dietary protein concentration was maintained with as few as six pigs/pen (Figure 3). For gilts, four pigs/pen was adequate (Figure 4). These results indicate that it may be best to pick pigs from large pens instead of selecting all pigs for blood sampling. Future studies will focus on using plasma urea profiles to examine the response of pigs to dietary protein intake. We believe that, with proper care, this technique is an excellent alternative to using growth performance data to assess the response of pigs to dietary protein concentration.

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