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A major challenge to improving swine feeding programs is adopting new techniques to improve the accuracy of determining protein requirements.

This is important for a variety reasons: First, there are currently many different commercial populations of pigs (commonly called genotypes) and these different populations may have different protein requirements because of their different lean growth potentials. Secondly, dietary protein levels should be carefully tailored to pigs' lean growth potential because both inadequate and excessive feeding of protein can reduce performance and increase production costs. Finally, it is too expensive and time consuming to perform traditional feeding and carcass analysis experiments for every possible population. Therefore, a simple procedure to identify protein requirements of growing-finishing pigs is needed.

This study investigated the use plasma urea concentrations as an index of the protein requirements of different pig populations. Plasma urea was chosen because urea is produced when the amino acids that make up proteins are broken down. High plasma urea concentrations may indicate that too much protein is being fed.

Procedures

Our experiments included two pig populations that we expected to have different protein requirements: Nebraska Gene Pool pigs (from the University herd) and modern Hampshire pigs (from a Nebraska SPF breeder).

The Gene Pool population is a 14-breed composite, formed from 1962 to 1965 and then closed to outside breed introductions. Since 1967 it has been selected only for reproductive traits. Therefore, growth and carcass characteristics of the Gene Pool population are typical of pigs 30 years ago. The Hampshire pigs have been selected for lean growth traits and represent pigs of a fairly high lean growth type.

Seventy-two gilts were allotted in a randomized complete block experiment with a 2 × 6 factorial arrangement of treatments. There were the two populations of pigs and six protein levels (10, 13, 16, 19, 22, and 25% crude protein [CP]). Diets (Table 1) were corn-soybean meal-based and were fortified to meet or exceed the National Research Council requirements of 44- to 110-lb pigs. The range of CP levels was obtained by changing the ratio of corn and soybean meal.

Pigs were housed individually and had *ad libitum* access to feed and water throughout the experiment. The initial weight was 63 lb and the final weight was 250 lb. The test period lasted 14 wk for Hampshire pigs and 16 wk for Gene Pool pigs.

Our first goal was to determine whether pigs of the two populations have different protein requirements. Significant differences between the two populations were found for growth performance, carcass traits, and the rates at which tissue was deposited. Population × protein level interaction was significant for protein accretion. Hampshire pigs had a greater magnitude of response to increased dietary protein concentration than did Gene Pool pigs (details of this part of the research were described in the 1994 Nebraska Swine Report).

Each week during the experiment blood samples were collected from the pigs and the plasma was analyzed for urea. Plots of urea concentrations against time were examined to see whether differences between the two populations of pigs and differences during the time course of the experiment could be identified.

Table 1. Composition of diets[a]

	Dietary protein concentration, %					
Item	10	13	16	19	22	25
Ingredient, %						
Corn	92.10	84.00	75.65	67.25	59.00	50.80
Soybean meal, 44% CP	5.00	13.25	21.75	30.25	38.65	47.00
Dicalcium phosphate	1.40	1.25	1.05	.90	.70	.55
Limestone	.40	.40	.45	.50	.55	.55
Salt	.30	.30	.30	.30	.30	.30
Trace mineral premix	.10	.10	.10	.10	.10	.10
Vitamin premix	.70	.70	.70	.70	.70	.70
Nutrient composition[b]						
Crude protein, %	9.75	12.53	15.53	18.61	21.33	24.29
Lysine, %	.36	.55	.75	.95	1.16	1.35
Calcium, %	.64	.62	.62	.63	.64	.62
Phosphorus, %	.56	.53	.53	.53	.51	.51
Metabolizable energy, kcal/lb[c]	1,502	1,496	1,491	1,485	1,480	1,475

[a] As-fed basis.
[b] Analyzed composition.
[c] Calculated.

Results

Plasma urea analyses results are illustrated in Figure 1. In the Gene Pool pigs, plasma urea concentrations of pigs fed the two lowest levels of protein (10 and 13%) remained low and relatively constant for the first half of the experiment. However, urea concentrations of pigs fed diets with ≥ 16% CP increased almost immediately and remained elevated throughout the experiment. For pigs in these groups (16, 19, 22, and 25% CP), plasma urea concentration increased with increases in dietary protein level.

These findings are interpreted to mean that during the first half of the experiment the protein requirements of Gene Pool pigs were between 13 and 16% CP. During the second half of the experiment, urea concentrations of pigs fed 13% CP steadily deviated from those of pigs fed 10% CP. We interpret this to mean that as the pigs gained weight their protein requirements (as a percentage of the diet) decreased and that during the final phase of the experiment the protein requirement of Gene Pool pigs was between 10 and 13% CP.

For Hampshire pigs, urea concentrations of pigs fed diets with 10, 13, 16, and 19% CP were similar for the first 3 weeks of the experiment, indicating that during this period the requirement was ≥ 19% CP. From 3 to 12 weeks the requirement seemed to be between 16 and 19% CP. After 12 weeks of the experiment, urea concentrations of pigs fed 16% CP deviated from those fed 10 or 13% CP. We interpret these findings to mean that Hampshire pigs required 19% CP from wk 0 to 3 (66 to 100 lb body weight), 16% CP from wk 3 to 12 (100 to 220 lb body weight), and 13% CP after wk 12 (220 to 250 lb body weight).

Thus, the protein requirements determined using plasma urea concentration indicated differences between the two populations. The differences were similar to the results based on growth performance and carcass traits. However, the technique of plasma urea concentration seemed to reflect the protein requirements of the two populations of pigs more precisely and dynamically than growth performance and carcass characteristics. Although more work will be needed to adapt this technique for practical on-farm use, the plasma urea technique may provide a valuable index to help identify whether the protein needs of pigs are being met or whether protein is being overfed.

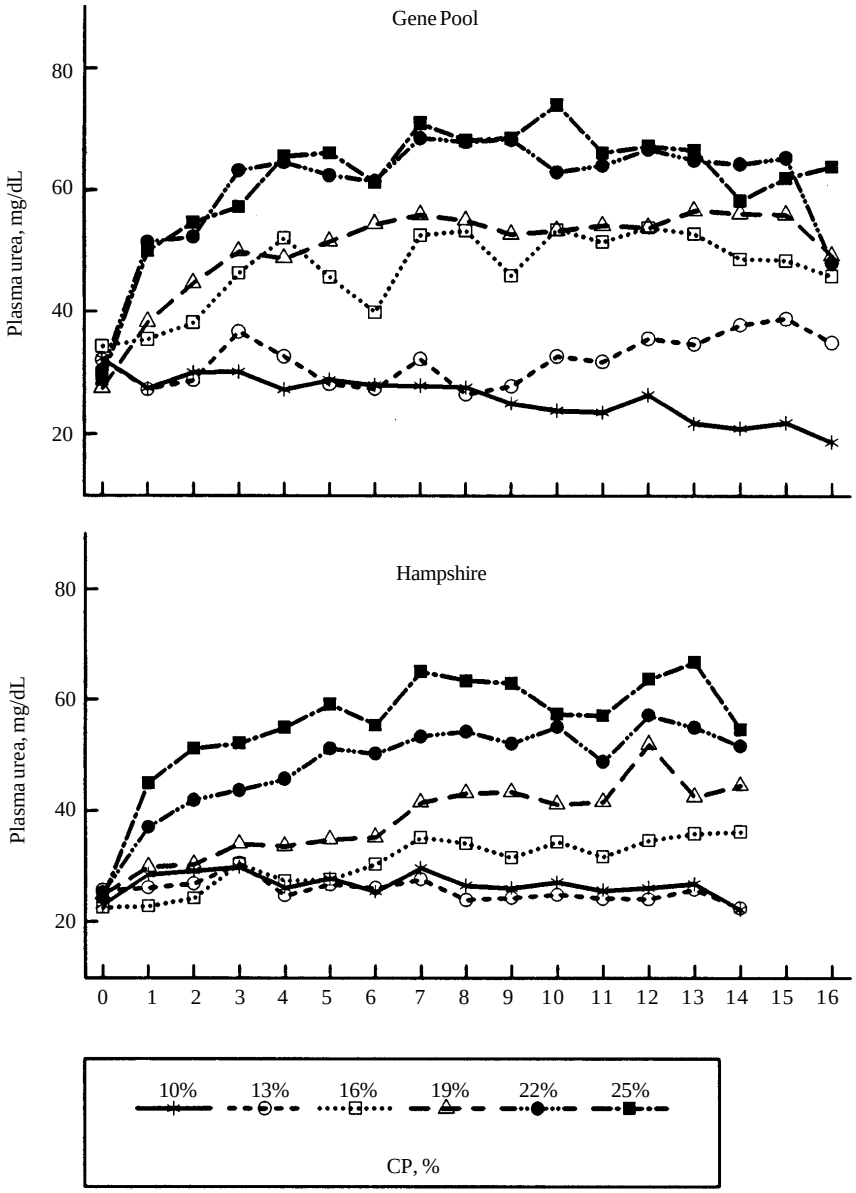

Figure 1. Plasma urea concentrations of two populations of pigs.

Conclusions

When conditions are properly controlled, the plasma urea concentration of growing-finishing pigs is a valuable index of whether the dietary protein content is deficient, adequate, or excessive. When adapted for practical on-farm use, this method could provide a valuable tool for adjusting dietary protein levels for differing populations that vary in lean gain potential. Additional research is still required to evaluate the effects of factors such as sex, protein quality, use of crystalline amino acids, and energy intake on plasma urea concentration.

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