THE USE OF REAL-TIME ULTRASOUND TO MODEL THE GROWTH PERFORMANCE AND LYSINE REQUIREMENTS OF GROWING-FINISHING PIGS ON COMMERCIAL FARMS

J. W. Smith, II, M. D. Tokach, A. P. Schinckel[1], S. S. Dritz, J. L. Nelssen, and R. D. Goodband

Summary

Eighty pigs, 40 barrows and 40 gilts, on two commercial finishing operations were used to model growth and accretion rates. Major differences were observed between the two farms. This analysis indicates that real-time ultrasound can be used to develop lean and lipid accretion curves for formulating farm-specific diets that optimize lean growth performance in commercial operations

(Key Words: Ultrasound, Growth, Modeling, Performance.)

Introduction

Currently, swine nutritionists formulate diets based upon estimates of lean accretion, lipid accretion, and protein requirements determined in controlled settings on university or company research facilities. However, implementing these recommendations on individual farms is difficult because of the differences in feed intake, disease status, stocking density, management, and a plethora of other factors. Researchers at Purdue University have developed models to determine the growth and accretion rates of pigs. However, this technique has not been tested in commercial operations. Therefore, this study was designed to evaluate whether real-time ultrasound could be used to model the growth performance and lysine requirements of growing-finishing pigs on commercial farms.

Procedures

Eighty pigs (40 barrows and 40 gilts) on two commercial farms were used. Pigs were tagged, weighed, and scanned within 1 week of placement in the finishing facility. Subsequently, pigs were weighed and scanned every 3 weeks until all pigs in the facility were marketed. Pigs used in the study were marketed as a group to remove biases caused by fast growth rate of individual pigs.

Growth and real-time ultrasound data were used to determine growth, protein, and lean accretion curves based on models developed at Purdue University. Metabolizable energy requirement curves were determined by the following equation:

$$\begin{aligned}\text{Metabolizable Energy Requirement} =\ & (.4 \times \text{Empty Body Protein}^{.78}) + \\ & (.4 \times \text{Protein Accretion}) + \\ & (10.53 \times \text{Protein Accretion}) + \\ & (12.64 \times \text{Lipid Accretion})\end{aligned}$$

This equation estimates the feed intake in Mcal needed to meet the pigs energy needs based upon its growth and composition. Metabolizable energy requirement is then divided by the energy content of the diet to determine the estimated daily feed requirement.

Lysine requirements for each gender of pig on each farm was determined by estimating the maintenance lysine requirement and the lysine requirement for lean growth.

[1]Department of Animal Science, Purdue University, West Lafayette, IN.

Adjusting for the digestibility and efficiency of lysine utilization allows determination of the total lysine requirement. For this analysis, maintenance lysine requirement was estimated by :

$$\text{Maintenance Lysine Requirement} = .036 \times \text{Body Weight}^{.75}$$

Lysine requirement for lean-gain was estimated by:

$$\text{Lysine Requirement for Lean-Gain} = (.066 \times \text{Body Weight}) \div .65$$

where .066 is the lysine content of muscle, and .65 is the efficiency of lysine utilization. Total lysine requirement was determined by:

$$\text{Total Lysine Requirement} = (\text{Maintenance Lysine Requirement} + \text{Lysine Requirement for Lean-Gain}) \div .80$$

where .80 is the digestibility of lysine.

Results and Discussion

Growth rates were greater for pigs on Farm 1 than pigs on Farm 2 (Figure 1). As expected, barrows grew faster than gilts on the respective farms. The most striking observation was the drastic decrease in growth rate of the barrows on Farm 1 after reaching a peak of 2 lb/d at 145 lb body weight. As will be discussed later, this has a major impact upon the lysine requirements of these pigs. Typically, growth rate for finishing pigs is determined by dividing total weight gain by the numbers of days in the facility. If this were plotted on Figure 1, it would appear as a straight line across the graph and would not account for the dynamics of pig growth. To illustrate this concept, we will examine the performance to the barrows on Farm 1. These pigs were fed for 117 days, beginning at 56 lb and ending at 266 lb, resulting in an ADG of 1.79. This would be considered excellent performance by most producers. However, this masks the fact that the growth rate of these barrows decreased dramatically after the midpoint of the finishing phase.

Body composition, as determined by real-time ultrasound, is presented as empty body protein and empty body lipid accretion. The protein accretion curves (Figure 2) are similar to the average daily gain curves. However, the protein accretion for barrows on Farm 1 does not fall below that of pigs on Farm 2. indicating that although their growth decreases, the composition of their growth is still better than that of the pigs on Farm 2. The shape of the two barrow protein accretion curves is similar; however, the gilts from Farm 2 do not mimic the protein gain of the gilts from Farm 1. Normally, lean-gain for a commercial operation is established by determining initial lean and carcass lean from NPPC equations and packer carcass performance sheets and dividing lean-gain by days on feed. As with ADG, this gives a single mean for the entire growing-finishing period. By using real-time ultrasound to determine actual daily lean-gain, producers can better assess the quality of their genetics and more importantly can visualize how feeding pigs to heavier weights affects their growth and composition.

Lipid accretion (Figure 3) increased for all pigs as weight increased. The decreasing slope of the lipid accretion of the barrows from Farm 1 beginning at 180 lb is surprising. However, this is primarily a function of overall growth performance. These barrows dramatically decreased growth rate during this period. The barrows from Farm 2, in addition to having the lowest protein deposition rate, had the greatest lipid accretion rate.

The estimated daily feed requirement (Figure 4) was determined from the accretion rates and body compositions of the pigs. Estimated daily feed requirements, as expected, increased as the weight of the pigs increases. It is important to note that this is not daily feed intake. The estimated daily feed requirement is the estimated feed needed to sustain the pig's growth and composition. The daily feed intake may be greater because of feed wastage, variations in protein and energy utilization, and environment.

Total lysine needs (Figure 5) in g/d were determined based upon lean composition and accretion. The lysine needs of the pig follows that of lean accretion. Simply stated, the greater the lean accretion, the greater the lysine requirement. Surprisingly, the lysine requirement of any of the pigs did not reach 20 g/d or even 18 g/d. Typically, lysine requirements are determined by feeding several levels of lysine and then using feed disappearance data, transformed to daily lysine requirement. This method yields a greater requirement because of the factors affecting feed disappearance. The pig actually may be consuming 18 g/d, but with wastage factored in, 20 g/d may be leaving the feeder.

Total lysine needs were determined on a percentage of diet (Figure 6) by dividing the lysine requirement by the estimated daily feed requirement. Based upon this analysis, Farm 2 is overfeeding lysine especially in the late finishing phase. As expected, the pigs on Farm 1 have a greater lysine requirement as a percentage of the diet.

Implications

Progressive pork producers are demanding diet formulations that are designed specifically for their operations. However, without the use of real-time ultrasound and this type of analysis, nutritionists cannot estimate the dynamics of the growth performance of pigs on a specific operation. Unless an analysis like this is adapted, diets will continue to be formulated for the average and, in most cases, will not meet the specific requirements for the operation.

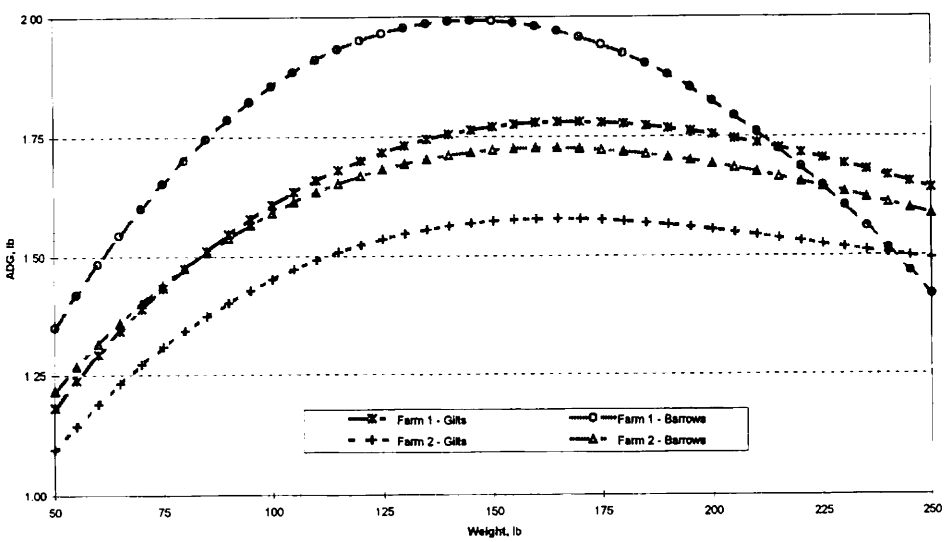

Figure 1. Modeled Average Daily Gain for Barrows and Gilts

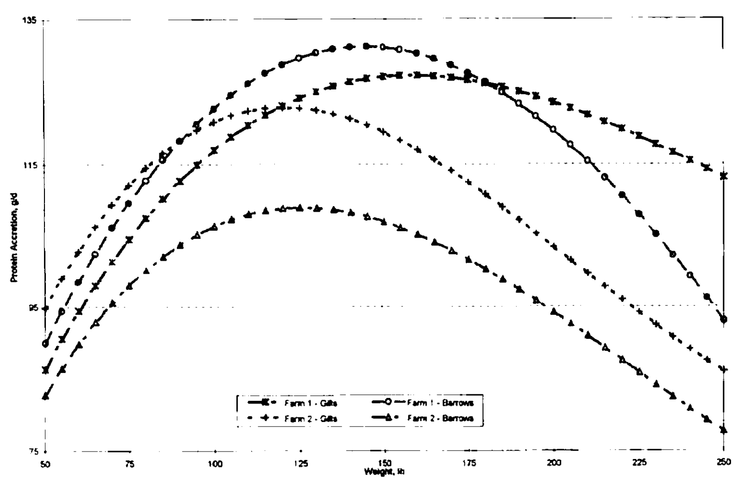

Figure 2. Modeled Empty Body Protein Accretion for Barrows and Gilts

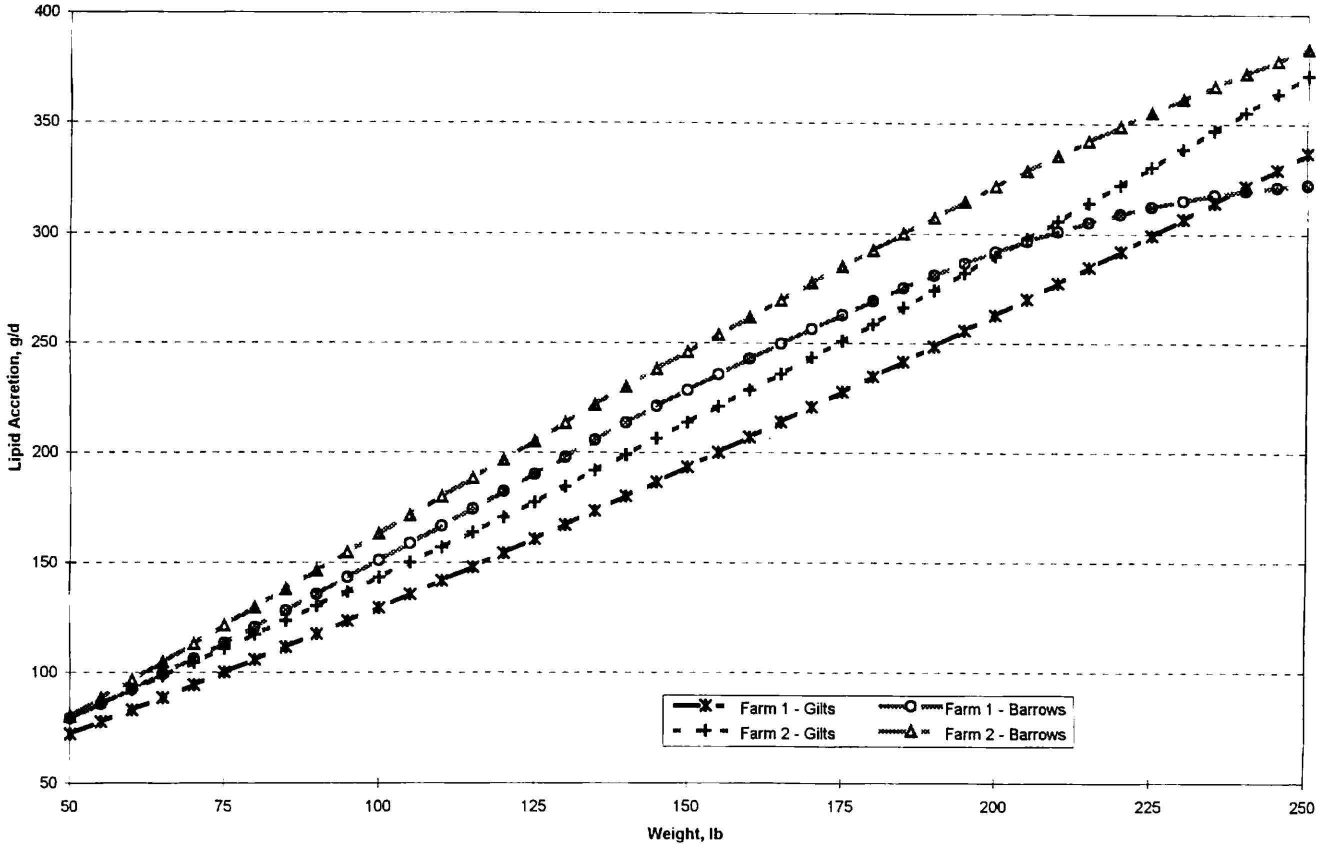

Figure 3. Modeled Empty Body Lipid Accretion for Barrows and Gilts

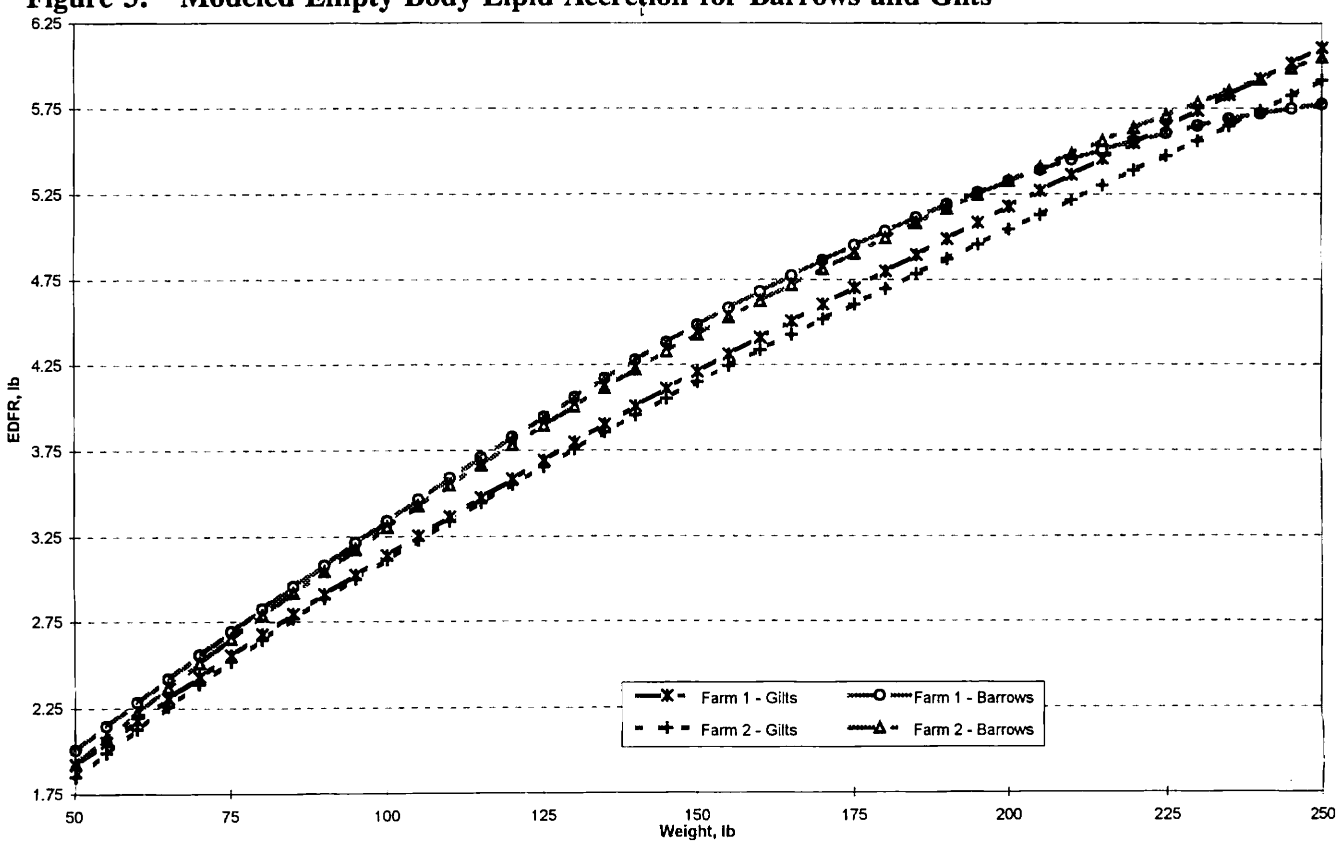

Figure 4. Estimated Daily Feed Requirement Based upon Protein Accretion and Maintenance

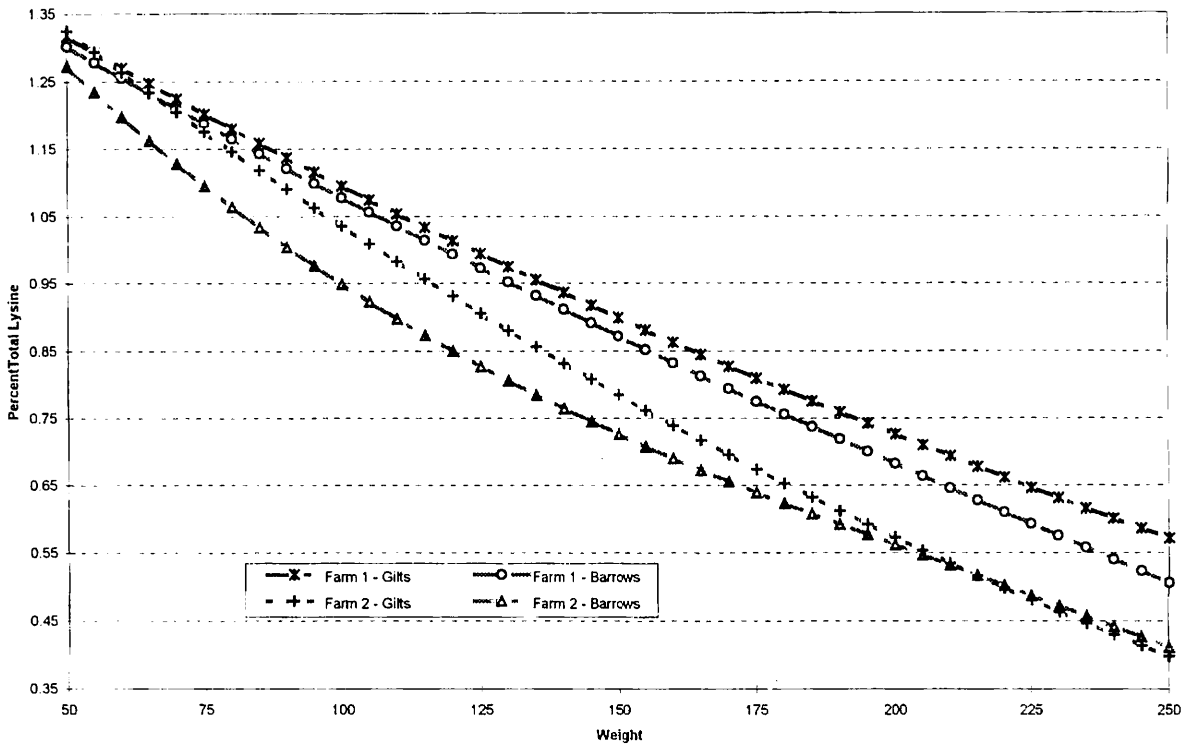

Figure 5. Total Lysine Needs Based upon Modeled Protein Accretion

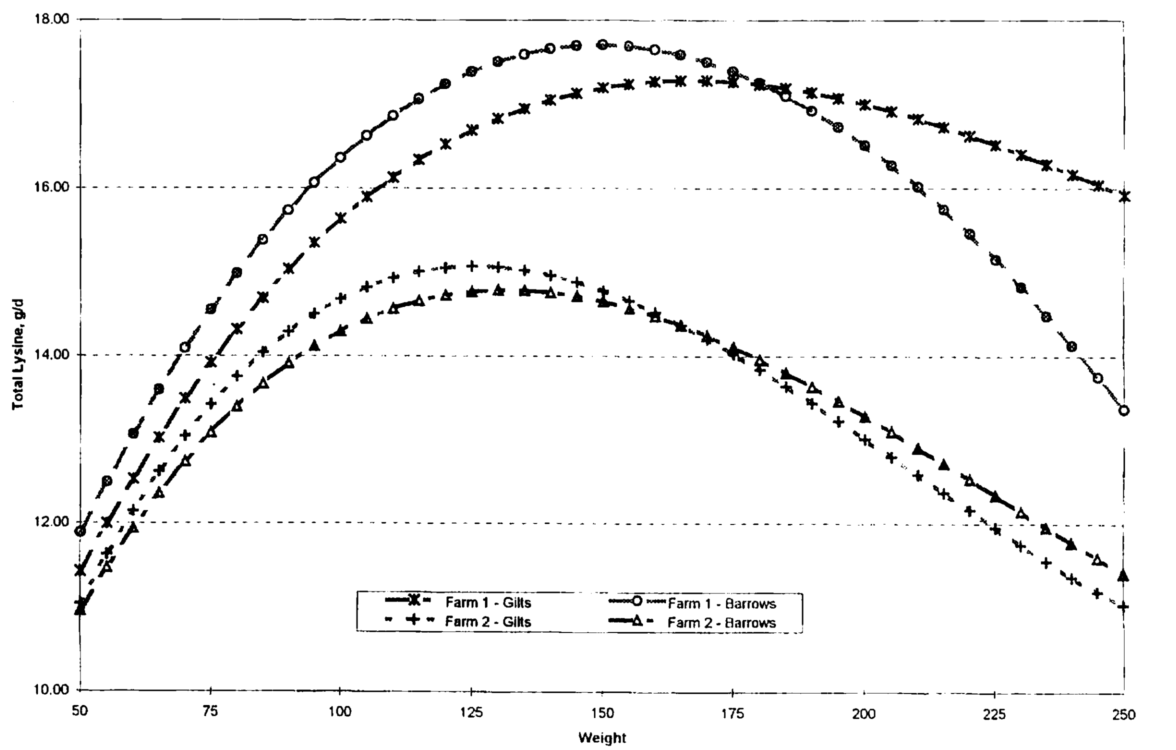

Figure 6. Percent Dietary Lysine Based upon Modeled Protein Accretion and Estimated Daily Feed Requirement