Growing–Finishing Pig Recommendations

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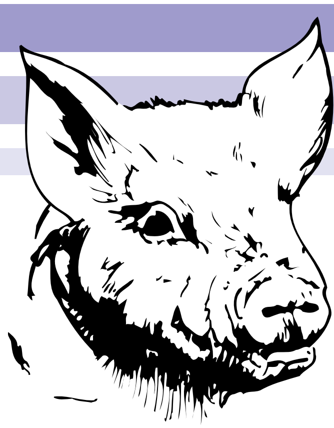


Kansas State University Agricultural Experiment Station and Cooperative Extension Service

Introduction

Many dietary and non-dietary factors impact optimum growth performance and economics of feeding growing and finishing pigs. The use of high lean genotypes and high health technologies, such as segregated production, have lead to wider variations in growth performance than ever before. However, protein and energy have remained the nutrients with the largest impact on feed cost in the finishing barn. Therefore, a wider variety of diet formulations are needed across swine operations to capture the most economical feed cost per pound of gain. Research efforts at Kansas State University have concentrated on developing cost effective and readily applied tools to improve grow–finish feed cost and growth performance. Integrating the biologic principles of growth and their impact on nutrient requirements with practical methods to formulate and deliver the most economical diets to groups of pigs has lead to development of these tools. The tools include methods to: (1) determine farm-specific lysine recommendations; (2) evaluate the economics of adding fat or other ingredients to grain-soybean meal based diets; (3) calculate feed budgets; and (4) account for variation in F/G between groups.

As with most decision-making tools, including more information in the decision-making process will improve the confidence in the resulting nutrient recommendations. However, the cost of obtaining the detailed information needs to be balanced with the expected cost savings from implementing the extra information. Therefore, these tools were developed for use in a generalized manner when a minimal amount of production information is available or can be easily customized to a particular situation when more detailed production information is available.

How do you determine the optimum grow–finish diet formulation?

There are two different approaches to establishing optimum nutrient fortifications in grow–finish diets. The traditional approach has been that nutrient intake will dictate growth rate and carcass leanness. For example, a pig will grow only as fast or become as lean as the diet it is offered will allow (providing genetic capacity for lean growth is not limiting). The major difficulty of this approach in commercial production systems is accurately predicting feed intake. There are too many factors affecting feed intake, with varying degrees of influence, to practically apply the results on a widespread commercial basis. A second approach is that a combination of growth rate, efficiency, and tissue accretion will dictate nutrient intake. An example of this approach would be to determine daily protein accretion of a group of pigs, then calculate the requirements of amino acids and energy necessary to deposit that amount of protein. We have chosen this second approach because of the consistency and ease of data collection.

What is a systematic way to approach designing a nutritional program for grow–finish pigs?

The systematic approach that we use includes several steps. First, we establish protein and fat deposition curves. These curves are used to determine a lysine to calorie ratio to drive the observed growth. Then, we decide whether fat or other ingredients are economical to include in the grain-soybean meal based diets. These decisions will impact the energy density of the diet. Using the lysine to calorie ratio and energy density of the diet, a dietary percentage is determined. The requirements for other amino acids are determined based on a ratio of the lysine level. Then, levels are set for other nutrients, such as calcium, phosphorus, trace minerals and vitamins. Next, a feed budget is determined according to the feed efficiency projected for the group to facilitate delivery of the correct phases. Finally, performance of the grow–finish group is monitored to make sure that projected growth performance targets are being achieved.

Why is the lysine requirement expressed as a lysine to calorie ratio instead of a dietary percentage?

The lysine requirement is expressed as a ratio instead of dietary percentage because as the energy density of the diet increases either feed intake decreases and (or) growth rate increases. Therefore, when feed intake decreases with more energy dense diets, the grams of lysine remains similar resulting in the need for a higher dietary lysine percentage. A similar result occurs if energy density results in increased growth rate while feed intake remains constant. However, in this case more grams of lysine are needed to drive growth even though the same amount of diet is consumed. Both scenarios require higher dietary lysine percentages but the amount of lysine needed per calorie of energy remains relatively constant. Thus, the lysine to calorie ratio is used to ensure the right amount of lysine is provided in diets that vary in energy density.

Amino Acid Levels

How do you determine lysine requirements for various operations and genotypes?

Lysine requirements can be determined in one of two manners. If the producer collects the necessary weight and ultrasound information, lysine requirement curves can be developed specifically for the individual operation and genotype.

If the detailed information is not available, fat free lean index (FFLI) can be used to develop more generalized recommendations.

How is ultrasound information used to determine lysine requirements?

In order to develop farm-specific lysine recommendations, growth curve data can be translated into nutrient requirements based on the concepts of Dr. Allan Schinckel at Purdue University. Briefly, the procedure involves weighing and obtaining ultrasound measurements for backfat and loin area at approximately 5 to 6 points during the growth period between 50 and 280 pounds. The ultrasound and weight measurements are used to determine the amount of body protein and lipid at each weight. Daily protein and lipid accretion curves are then calculated. The daily lysine requirement in grams per day can then be calculated from daily body protein accretion (P) using constants for the lysine content of protein (L), the efficiency of lysine utilization (E), the maintenance requirement (M), and digestibility (D).

$$\text{g/day} = \frac{M + \frac{P \times L}{E}}{D}$$

Table 1. Constants to Convert Daily Protein Accretion into Daily Lysine Requirement.

Parameter	Constant or Equation
Lysine content of body protein, L	6.6%
Post-absorptive efficiency of lysine utilization, E	65%
Digestibility of lysine in the diet, D	80%
Lysine needed for maintenance, M	.036 × Weight, $\text{kg}^{.75}$

Total lysine requirement,

Daily energy intake driving the observed growth is then calculated from the daily protein and lipid accretion with an allowance for the maintenance energy requirement. The grams of lysine intake can then be divided by the daily energy intake to derive a lysine to calorie ratio that can be converted to a dietary percentage based on the dietary energy concentration. The dietary percentage can be converted into a curve based on body weight. The curve can be used to determine a dietary lysine percentage for each phase.

How is fat free lean index used to make lysine recommendations?

Equations have been developed by K-State Research and Extension that use body weight and fat free lean index (FFLI) to predict a lysine to calorie ratio. This approach requires assumptions on the shape of the curves for growth and protein deposition and that the rate of lipid deposition is dependent on the FFLI at market weight. The lysine to calorie ratio along with the energy density of the diet can then be used to determine a dietary lysine recommendation.

Separate equations were developed for barrows and gilts (Table 2). These equations were used to develop Figures 1 to 4 and the lysine recommendations in Table 3 and 4.

The use of the equation is demonstrated below. A group of gilts that weighs 150 pounds and has a FFLI of 50.0 percent at 265 pounds results in a dietary lysine to calorie ratio of 2.43 grams of Lysine per Mcal of ME.

$$2.43 \text{ g/Mcal} = .019 * 150 - .3369 * 50 + .000021 * 150^2 + .00578 * 50^2 - .000739 * 150 * 50 + 7.046$$

The dietary lysine percentage can then be determined by multiplying the lysine:calorie ratio times the energy level in the diet with the appropriate conversion factors from the metric to english system:

(Lys:Cal * Mcal/lb of feed * 2.205) /10 = Dietary lysine percentage

The group of 150-pound gilts with an expected FFLI of 50 percent has a predicted dietary lysine requirement of: (2.43 * 1.515 * 2.205) / 10 = .81%

Figures 1 and 2 depict the change in lysine: calorie ratio as the pig grows. Similarly, Figures 3 and 4 depict the dietary lysine needs for pigs fed diets containing 1,505 kcal/lb. This is the energy level of a corn-soybean meal based diet without any dietary fat added. Also, note that the variations in lysine levels among pigs with different FFLI are much greater at lighter weights than at heavier weights. The implication is that phase feeding

Table 2. Equations to Determine Lysine to Calorie Ratios from FFLI and Weight.

Barrows =	0.0116 * WT - 0.3799 * FFLI + 0.000026 * WT^2 + 0.006052 * $FFLI^2$ - 0.000628 * WT * FFLI + 8.68
Gilts =	0.019 * WT – 0.3369 * FFLI + 0.000021 * WT^2 + 0.00578 * $FFLI^2$ - 0.000739 * WT * FFLI + 7.046
Where:	Lys:Cal = Grams of total dietary lysine per Mcal of ME WT = Body weight in pounds FFLI = Pounds of fat free lean per 100 lbs of carcass

Figure 1. Recommended Lysine:Calorie Ratio for Gilts Based on Fat Free Lean Index.

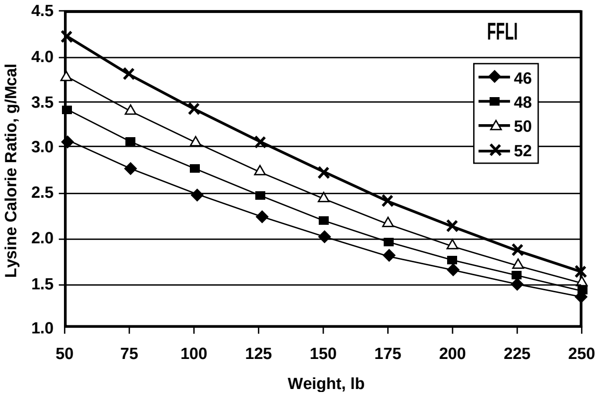


Figure 2. Recommended Lysine:Calorie Ratio for Barrows Based on Fat Free Lean Index.

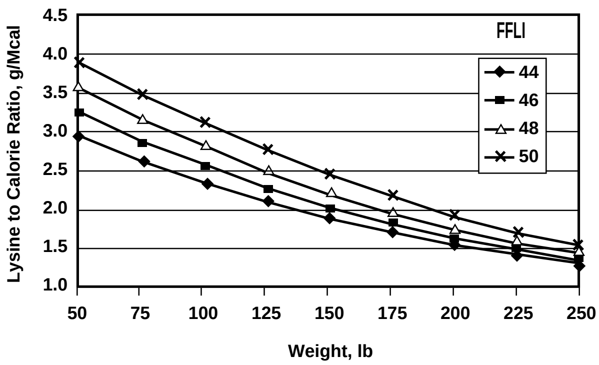


Figure 3. Recommended Total Dietary Lysine Percentages for Gilts Based on Fat Free Lean Index for Diets Containing 1505 kcal/lb.

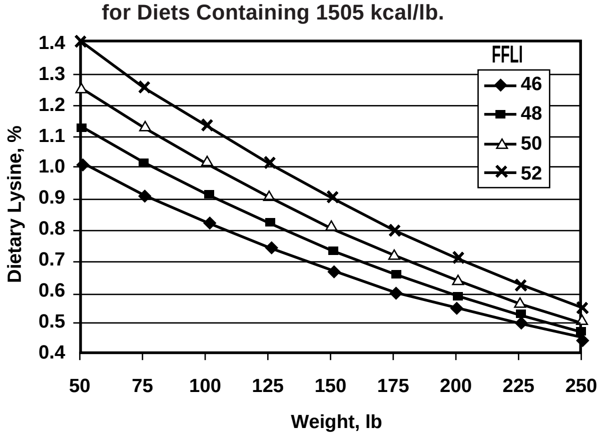
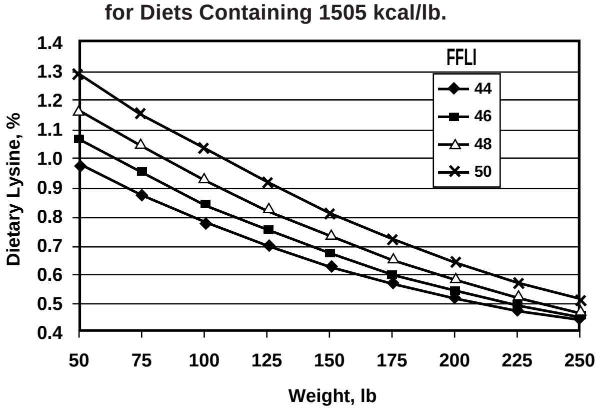


Figure 4. Recommended Total Dietary Lysine Percentages for Barrows Based on Fat Free Lean Index for Diets Containing 1505 kcal/lb.



programs are even more important to economically feed pigs with a high lean growth potential.

How are these recommendations used to make practical diets?

The equations listed in Table 2 or Figures 1 to 4 can be used to determine the appropriate lysine level for any weight range in the grow–finish period. An example of using these data to provide dietary recommendations is shown in Tables 3 and 4. The lysine:calorie ratios listed in Table 3 were used to develop the suggested lysine percentages listed in Table 4. The dietary energy level for the recommendations in Table 4 was assumed to be 1,505 kcal/lb, the level of energy in corn-soybean meal based diets without added fat. As the energy level of the diets increase or decrease, the dietary lysine percentage must be changed to maintain a constant lysine:calorie ratio. Milo-soybean meal based diets without added fat will contain approximately 1455 kcal/lb. Thus, diets containing milo instead of corn could be formulated to contain 3 percent less lysine and have the same lysine: calorie ratio as a corn-based diet.

Suggested diets for grower and finisher pigs are listed in Tables 6 and 7. These diets are formulated for terminal market pigs. If gilts are destined for the breeding herd, higher levels of calcium and phosphorus should be fed.

Are these the most economical dietary lysine percentages?

The dietary lysine percentages were determined using the average level of protein deposition calculated from past performance. The influence that variation in protein deposition within a group has on dietary economics has not been considered. Even if variation was included, the results will not be the most economical lysine levels for all situations. As the price of grain and protein sources increases and decreases, the optimal lysine level will change. Similarly, market price, facility cost, and other variables will influence the calculation of the most optimal lysine level.

How do you determine the requirements for the other amino acids?

After the dietary lysine percentage is determined, levels for other essential amino acids are determined by using a ratio for each amino acid relative to lysine. This ratio of amino acids is often called an “ideal amino acid pattern.” Considerable debate exists on the appropriate ideal amino acid pattern to use for grow–finish pigs. The pattern also can be expressed on a total amino acid basis, apparent digestible basis, or true digestible basis. The patterns listed in Table 5 were adapted from work at several universities.

The isoleucine requirement may be lower

Table 3. Recommended Lysine to Calorie Ratios (g/Mcal ME) based on Fat Free Lean Index.

	Sex:	Barrow				Gilt			
Weight Range, lb	FFLI:	44	46	48	50	46	48	50	52
50 to 80		2.75	3.00	3.29	3.64	2.89	3.21	3.57	3.98
80 to 120		2.34	2.54	2.79	3.09	2.49	2.75	3.06	3.42
120 to 160		1.94	2.10	2.30	2.55	2.09	2.30	2.55	2.85
160 to 200		1.64	1.74	1.89	2.09	1.76	1.91	2.10	2.34
200 to 250		1.39	1.44	1.53	1.67	1.47	1.55	1.68	1.85

Table 4. Recommended Total Dietary Lysine Percentages based on Fat Free Lean Index for Diets Containing 1505 kcal/lb.

	Sex:	Barrow				Gilt			
Weight Range, lb	FFLI:	44	46	48	50	46	48	50	52
50 to 80		.91	.99	1.09	1.21	.96	1.06	1.18	1.32
80 to 120		.78	.84	.93	1.03	.83	.91	1.02	1.13
120 to 160		.65	.70	.76	.85	.69	.76	.85	.94
160 to 200		.54	.58	.63	.69	.59	.63	.70	.78
200 to 250		.46	.48	.51	.56	.49	.52	.56	.61

than these estimates while the requirements for threonine and methionine and cystine may be higher. There is not sufficient data to establish a better estimate.

Can I use more than 3 pounds of synthetic lysine per ton of feed?

In practical terms, the use of an ideal amino acid pattern determines the amount of synthetic lysine that can be used in a grain-soybean meal based diet. Under most practical conditions when a maximum of 3 pounds of synthetic lysine is used, lysine will be the limiting amino acid. When using alternative feed ingredients or very high or low protein diets, the individual situation must be analyzed. In many of these cases, less synthetic lysine should be used in the diets unless other synthetic amino acids also are added.

What about ideal protein diets containing high levels of synthetic amino acids?

In certain situations, it may be desirable to use high levels of synthetic amino acids in the diet to decrease nitrogen excretion. Using 3 pounds of L-lysine HCl per ton to replace soybean meal in the diet will decrease nitrogen excretion by 20 percent. Higher levels of synthetic lysine in combination with other synthetic amino acids can be safely used in the diets and nitrogen excretion can be decreased by over 40 percent. However, producers should not expect an improvement in pig performance. A review of the numerous trials conducted in this area reveal the following facts. First, reducing the crude protein content of the diet by adding synthetic amino acids will not result in superior performance to an intact protein source, such as soybean meal. Second, although the evidence is not conclusive, using high levels of synthetic amino acids usually results in increased back fat compared to feeding intact protein sources.

Dietary Fat Additions

How do I determine whether to use other ingredients in my milo- or corn-soybean meal based diets?

Several other ingredients may be used in traditional grain-soybean meal based diets to decrease cost. Each of these ingredients must be evaluated individually following the guidelines in the factsheet, *General Nutrition Principles for Swine*, MF2298.

Table 5. Total and Digestible Amino Acid Ratios for Grow–Finish Pigs (50 to 250 Pounds).

Amino Acid	Total basis	True digestible	Apparent digestible
Lysine	100	100	100
Methionine	27.5	27.5	27.5
Met & Cys	55	52	52
Threonine	65	62	58
Tryptophan	18	19	17
Isoleucine	60	60	60

Table 6. Suggested Grower Diets.

	Grower diets without fat						Grower diets with 5% fat					
	Lysine, %						Lysine, %					
Ingredient, lb/ton	.80	.90	1.00	1.10	1.20	1.30	.85	.96	1.07	1.17	1.27	1.38
Corn or milo	1620.0	1551.0	1476.0	1405.9	1336.7	1261.5	1475.0	1401.0	1320.8	1245.6	1171.4	1091.2
Soybean meal, 46.5%	320	390	465	535	605	680	365	440	520	595	670	750
Choice white grease	0	0	0	0	0	0	100	100	100	100	100	100
Monocalcium phosphate, 21% P	25	24	24	24	23	23	25	24	24	24	23	23
Limestone	19	19	19	19	19	19	19	19	19	19	19	19
Salt	7	7	7	7	7	7	7	7	7	7	7	7
Vitamin premix	3	3	3	3	3	3	3	3	3	3	3	3
Trace mineral premix	3	3	3	3	3	3	3	3	3	3	3	3
Lysine HCl	3	3	3	3	3	3	3	3	3	3	3	3
DL-Methionine	0	0	0	0.1	0.3	0.5	0	0	0.2	0.4	0.6	0.8
TOTAL	2000.0	2000.0	2000.0	2000.0	2000.0	2000.0	2000.0	2000.0	2000.0	2000.0	2000.0	2000.0
Calculated Analysis												
Lysine, %	.80	.90	1.00	1.10	1.20	1.30	.85	0.96	1.07	1.17	1.27	1.38
Methionine:lysine ratio, %	31%	30%	28%	28%	28%	28%	30%	28%	28%	28%	28%	28%
Met & Cys:lysine ratio, %	68%	65%	62%	60%	59%	58%	65%	61%	60%	59%	58%	57%
Threonine:lysine ratio, %	74%	72%	70%	69%	68%	67%	72%	70%	68%	67%	66%	65%
Tryptophan:lysine ratio, %	22%	22%	21%	21%	21%	21%	21%	21%	21%	21%	21%	21%
ME, kcal/lb	1,502	1,502	1,502	1,501	1,501	1,501	1,600	1,600	1,599	1,599	1,599	1,598
Protein, %	14.3	15.7	17.1	18.4	19.7	21.2	14.8	16.2	17.7	19.1	20.6	22.1
Calcium, %	.66	.66	.67	.67	.67	.68	.66	.66	.67	.68	.68	.69
Phosphorus, %	.59	.59	.61	.62	.62	.64	.59	.59	.60	.62	.62	.63
Available phosphorus, %	.32	.32	.32	.32	.32	.32	.32	.32	.32	.33	.32	.32
Lysine:calorie ratio, g/Mcal ME	2.42	2.71	3.03	3.32	3.61	3.93	2.41	2.71	3.02	3.32	3.61	3.93

Table 7. Suggested Finisher Diets.

	Finisher diets without fat						Finisher diets with 5% fat					
	Lysine, %						Lysine, %					
Ingredient, lb/ton	.50	.60	.70	.80	.90	1.00	.53	.64	.74	.85	.96	1.07
Corn or milo	1820.5	1779.5	1704.5	1634.5	1559.5	1485.5	1690.5	1639.5	1564.5	1489.5	1409.5	1330.5
Soybean meal, 46.5%	130	170	245	315	390	465	160	210	285	360	440	520
Choice white grease	0	0	0	0	0	0	100	100	100	100	100	100
Monocalcium phosphate, 21% P	19	19	19	18	18	17	19	19	19	18	18	17
Limestone	17	17	17	18	18	18	17	17	17	18	18	18
Salt	7	7	7	7	7	7	7	7	7	7	7	7
Vitamin premix	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Trace mineral premix	2	2	2	2	2	2	2	2	2	2	2	2
Lysine HCl	2	3	3	3	3	3	2	3	3	3	3	3
DL-Methionine	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	2000.0	2000.0	2000.0	2000.0	2000.0	2000.0	2000.0	2000.0	2000.0	2000.0	2000.0	2000.0
Calculated analysis												
Lysine, %	0.50	0.60	0.70	0.80	0.90	1.00	0.53	0.64	0.74	0.85	0.96	1.07
Methionine:lysine ratio, %	41%	36%	33%	31%	30%	28%	38%	34%	31%	30%	28%	27%
Met & Cys:lysine ratio, %	91%	80%	73%	69%	65%	62%	85%	74%	69%	65%	62%	59%
Threonine:lysine ratio, %	90%	81%	77%	74%	72%	70%	86%	77%	74%	72%	70%	68%
Tryptophan:lysine ratio, %	25%	22%	22%	22%	22%	21%	24%	22%	22%	21%	21%	21%
ME, kcal/lb	1,511	1,510	1,509	1,508	1,508	1,508	1,609	1,608	1,607	1,606	1,606	1,606
Protein, %	10.8	11.5	12.9	14.3	15.7	17.1	10.9	11.8	13.3	14.7	16.2	17.7
Calcium, %	.54	.55	.56	.57	.58	.58	.54	.55	.56	.58	.59	.59
Phosphorus, %	.50	.50	.52	.52	.53	.54	.49	.50	.51	.51	.53	.53
Available phosphorus, %	.25	.25	.25	.25	.25	.25	.25	.25	.26	.25	.25	.25
Lysine:calorie ratio, g/Mcal ME	1.51	1.79	2.10	2.39	2.71	3.02	1.50	1.80	2.10	2.39	2.70	3.01

How do I determine whether to add fat to my milo- or corn-soybean meal based diets?

Assuming the fat is of acceptable quality, the economics of using added fat can be evaluated by calculating the diet cost with and without added fat. The percentage improvement needed to pay for the increased diet cost when adding fat is calculated by the following equation:

$$\frac{\text{Added fat diet cost} - \text{Without added fat diet cost}}{\text{Added fat diet cost}}$$

The expected improvement in F/G is 2 percent for every 1 percent added dietary fat. Therefore, if the percent improvement needed to justify the added fat diet cost is greater than the expected improvement in F/G, feeding the added dietary fat is economically justified on a feed efficiency basis. An example is depicted below in which the cost of a diet without added fat is $136/ton and the cost per ton with 5 percent added fat is $148. Thus, the F/G improvement needed to justify the higher priced added fat diets is (148–136)/148=8.1 percent. The added fat diet is economical to feed based on 8.1 percent being less than the expected improvement in F/G (10% for a diet with 5% added fat).

The breakeven diet cost can be calculated from the following formula:

$$\frac{\text{Without added fat diet cost}}{(1 - 2 \times \%\ \text{Added Fat})}$$

Therefore, the breakeven diet cost for a 5 percent added fat diet is $151.11 (136/(1–2*.05) when the diet without added fat is $136. Comparing the diets with and without added fat on an equal lysine to calorie ratio basis is an important point to remember. Also if the expected improvement in feed efficiency is less than 2 percent for each 1 percent added fat, the number 2 in the equation can be replaced with the percentage response expected for each 1 percent added fat.

What about the influence of dietary fat additions on ADG or backfat?

This equation for determining the economics of dietary fat additions is based on feed efficiency and does not take into account the impact of added dietary fat on ADG or the influence on backfat and carcass lean content. Current research suggests that the impact on ADG is greater during the grower and early finisher phase with little impact on ADG of pigs greater than 200 pounds. In addition to variable response in ADG, the value of the additional ADG is not the same in all situations. For example, the economic value of ADG is higher when finishing space is limited than when there is a shortage of pigs. In the first scenario, an extra pound from increased ADG is worth the margin over feed cost (market price minus feed cost). In the second scenario, extra pounds are only worth the savings in fixed costs.

Previous research has indicated that feeding added dietary fat increases carcass backfat and reduces carcass leanness. Other recent research indicates the impact on backfat and carcass lean is negligible with high-lean pigs in the summer time. Other considerations not accounted for in the equation are additional costs for the equipment and utility expenses to handle added dietary fat. An economic value also has not been determined for the impact of added dietary fat on dust control.

What are some general guidelines for added dietary fat usage?

1. Fat will be more economical in the grower diets than in finisher diets because grower diets are more expensive and increasing the energy density of the diet improves ADG more in grower pigs than finisher pigs.
2. When purchased competitively, fat from animal sources (choice white grease or high quality tallow) will almost always be economical in early grower diets.
3. Due to their high cost, fat from vegetable sources (soybean oil or corn oil) are rarely economical to add to the diet.
4. Some producers add fat to the diet for dust control even when not economical for growth performance.

Calcium & Phosphorus

What are the recommendations for calcium, phosphorus, trace minerals and vitamins?

Calcium and phosphorus recommendations are listed in Table 8. Although some research data suggests lower available phosphorus levels can be fed without influencing growth performance, field experience leads to these recommendations. Feeding diets with lower levels of phosphorus has resulted in increased trim loss in the processing plant due to vertebrae breaking

Table 8. Recommendations for Ca and P, %.

Weight range, lb	Total Ca	Total P	Available P
50 to 80	.75	.65	.34
80 to 120	.70	.60	.29
120 to 160	.55	.50	.21
160 to 200	.55	.50	.21
> 200	.50	.45	.18

during the stunning process. Vitamin and trace mineral specifications are listed in the factsheet, *Premix, Base Mix and Starter Diet Recommendations for Swine,* MF2299.

Feed Budgets

How can I assure that pigs are being delivered the right amount of diet for each weight range?

Feed budgets are used to ensure the right amounts of each diet are delivered to each group of pigs. A standard cumulative feed budget based on cumulative weight gain is listed in Table 9. The feed budget assumes that if ADG is different over a weight break that F/G will be unchanged. For example, the feed budget dictates that 100 pounds of feed is required for pigs to grow from 60 to 100 pounds, each pig will receive 100 pounds regardless of the growth rate. Thus, some pigs may take 23 days to consume the feed, while others may require 30 days. By feeding on a budget, the pigs will receive the correct amount of feed to grow to 100 pounds. If these pigs were fed on a time basis instead of a feed budget, the slower growing pigs would not reach 100 pounds before being switched to the next diet.

With a feed budget, feed deliveries can be tracked from one central location, such as the feed mill. The person in the finishing barn does not have to guess the weight of the pigs for determining which diet to order. The diet to be delivered to the group of pigs is automatically determined by the feed budget.

Use of feed budgeting has resulted in more accurate phase feeding by not over or under delivering diets for each phase. The tracking of feed deliveries from one central location has also lead to improved accuracy of feed records.

How do I use the feed budget chart in Table 9?

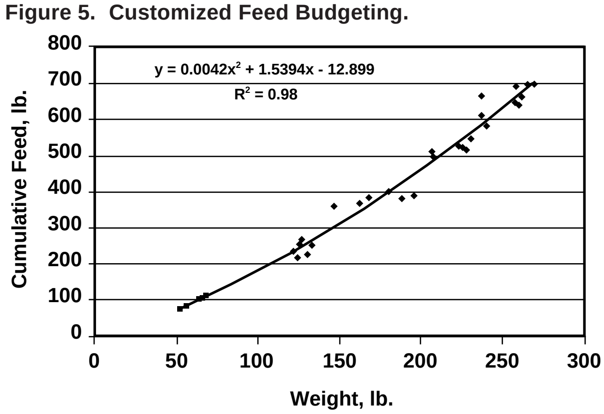
Determine the average weight of the group of pigs when placed in the barn and find the cumulative amount of feed on the feed budget chart. Next, find the cumulative amount of feed at the end of the weight break. Determine the difference and multiply by the number of pigs in the room. For example, grower 1 diet is fed from 50 to 80 pounds and a group of pigs are initially placed on feed at 52 pounds. The cumulative feed intakes to 52 and 80 pounds are 76 and 141 pounds, respectively. Therefore, this phase requires 65 pounds (141 – 76) of feed per pig or 19.5 tons for a 600-pig group. The subsequent phases are then calculated in the same manner.

The feed budget chart in Table 9 assumes a feed efficiency of 3.0 from 50 to 250 pounds. If feed efficiency is consistently higher or lower for a particular system, the budget can be scaled up or down to account for the change. The feed budget chart also is available from K-State Research and Extension in Excel or Lotus spreadsheets to easily adjust a feed budget based on overall close out feed efficiency and customized weight breaks (KSU Feed Budget Program).

How is a customized feed budget developed for a specific production system?

The feed budget chart shown in Table 9 will fit most production systems. With the advent of many large production systems that have similar feeding programs, genetics, and buildings, feed budgets developed specifically for a production system may be desirable. The basic approach is to randomly select six groups for each gender and track feed deliveries to the group. In addition, a random sampling of pens (three or four) in the group are weighed to determine the average pig weight of the group. Feed is inventoried on each weigh day and cumulative feed intake determined. The groups are followed as long as possible with the removal of as few of the pigs as possible. A minimum of 5 data points is needed to develop the curve. A curve can then be fit to the data and an equation derived to determine the cumulative feed intake. This can be easily accomplished by

Figure 5. Customized Feed Budgeting.



making an X–Y scatterplot in a spreadsheet and using the trendline function to obtain the equation for the curve (Figure 5). The customized budget for each phase can then be calculated by subtracting the cumulative intake at two different points.

Because feed is delivered to an individual group, the average curve is developed from a subsampling of groups within the production system. The development of feed budgets takes into account both the feed required for growth and feed disappearance due to wastage and can be customized for application to specific production systems.

What is the best way to determine the weight break for each phase?

Several factors are used to determine appropriate weight breaks. The nutrient requirements are rapidly changing during the grower and

Table 9. Standard Feed Budget Chart Based on a Feed Efficiency of 3.0 from 50 to 250 Pounds.

Pig weight	Total feed	Pig weight	Total feed	Pig weight	Total feed	Pig weight	Total feed	Pig weight	Total feed
9	0	68	110	126	258	184	434	242	640
10	1	69	112	127	261	185	437	243	644
11	2	70	115	128	263	186	440	244	647
12	3	71	117	129	266	187	444	245	651
14	6	72	119	130	269	188	447	246	655
15	7	73	122	131	272	189	450	247	659
16	8	74	124	132	275	190	454	248	663
17	10	75	126	133	277	191	457	249	667
18	11	76	129	134	280	192	460	250	671
19	12	77	131	135	283	193	464	251	675
20	14	78	133	136	286	194	467	252	678
21	16	79	136	137	289	195	470	253	682
22	17	80	138	138	292	196	474	254	686
23	19	81	141	139	295	197	477	255	690
24	20	82	143	140	298	198	481	256	694
25	22	83	145	141	300	199	484	257	698
26	24	84	148	142	303	200	487	258	702
27	25	85	150	143	306	201	491	259	706
28	27	86	153	144	309	202	494	260	710
29	29	87	155	145	312	203	498	261	714
30	31	88	158	146	315	204	501	262	718
31	33	89	160	147	318	205	505	263	722
32	34	90	163	148	321	206	508	264	726
33	36	91	165	149	324	207	512	265	730
34	38	92	168	150	327	208	515	266	734
35	40	93	170	151	330	209	519	267	739
36	42	94	173	152	333	210	522	268	743
37	44	95	175	153	336	211	526	269	747
38	46	96	178	154	339	212	529	270	751
39	48	97	180	155	342	213	533	271	755
40	50	98	183	156	345	214	536	272	759
41	52	99	185	157	348	215	540	273	763
42	54	100	188	158	351	216	543	274	767
43	56	101	191	159	354	217	547	275	772
44	58	102	193	160	357	218	551	276	776
45	60	103	196	161	360	219	554	277	780
46	62	104	198	162	364	220	558	278	784
47	64	105	201	163	367	221	561	279	788
48	66	106	204	164	370	222	565	280	793
49	68	107	206	165	373	223	569	281	797
50	70	108	209	166	376	224	572	282	801
51	72	109	212	167	379	225	576	283	805
52	75	110	214	168	382	226	580	284	809
53	77	111	217	169	385	227	583	285	814
54	79	112	220	170	389	228	587	286	818
55	81	113	222	171	392	229	591	287	822
56	83	114	225	172	395	230	594	288	827
57	85	115	228	173	398	231	598	289	831
58	88	116	230	174	401	232	602	290	835
59	90	117	233	175	404	233	606	291	840
60	92	118	236	176	408	234	609	292	844
61	94	119	238	177	411	235	613	293	848
62	96	120	241	178	414	236	617	294	853
63	99	121	244	179	417	237	621	295	857
64	101	122	247	180	421	238	624	296	861
65	103	123	249	181	424	239	628	297	866
66	105	124	252	182	427	240	632	298	870
67	108	125	255	183	430	241	636	299	875

early finisher phases. Therefore, lower feed budget amounts result in diets more closely matching the nutrient needs of the pigs.

Another method is to use weight breaks that budget similar amounts of feed for each break. Thus, the weight ranges decrease, as the pigs grow heavier. A major advantage of doing this is that it is easy to remember the amount needed for each phase. Monitoring of the budgets is simplified for personnel. Other factors commonly used to determine the budget are based on the size of feed bins, delivery compartments, and the size of batches at the mill.

Feed Efficiency Comparisons and Targets

What is the best biologic measure to monitor if detailed financial records are not available?

Feed efficiency is the best factor to measure because it directly impacts cost per pound of gain. However, several factors that improve feed efficiency also can increase cost so the lowest feed efficiency may not always be the lowest cost.

How do I compare feed efficiency among different groups?

Several factors impact feed efficiency. Expected feed efficiency will be influenced by the entry weight and market weight of the pigs, gender of the pigs, genotype, energy level of the diet, and whether the diets are pelleted. In order to compare feed efficiency among groups, adjustment factors for these major items must be used. Adjustment factors have been developed for entry weight and market weight of the pigs, energy level of the diet, and whether the diets are in pellet or meal form. Therefore, variation among close outs can be accounted for by these factors and may aid in detecting differences among groups for other factors, such as feed wastage.

The following equation can be used to compare different groups with different ending weights and market weights:

$$\text{Adjusted F/G} = \text{observed F/G} + (50 - \text{entry wt}) \times .006 + (250 - \text{market wt}) \times .006)$$

This equation adjusts all groups to a common entry weight of 50 pounds and market weight of 250 pounds. Further adjustments can be made to compare groups with different grain sources, dietary energy levels, and pelleted or meal diets. The adjustment for energy level uses an adjustment for grain source and fat level in the diet (grain factor – (fat level × 2)), where the grain factor is 1 for corn and 1.02 for milo and fat level is the percent fat in the diet. The adjustment for pelleting is (1– pellet factor), where the pellet factor is the percentage improvement in feed efficiency due to pelleting. These adjustment factors are used to develop the feed efficiency targets in Table 10.

The factors can be included in one formula to compare all of the factors at the same time:

$$\text{Adjusted F/G} = (\text{observed F/G} + (50 - \text{entry wt}) \times .006 + (250 - \text{market wt}) \times .006)) / [\text{Grain factor} - (\text{fat level} \times 2)) \times (1 - \text{pellet factor})]$$

As an example, a group of pigs with an entry weight of 40 lb and exit weight of 240 lb being fed a 5% added fat, corn-soybean meal based diet in a meal form has an adjusted feed efficiency of 3.00 with an observed feed efficiency of 2.59. (2.59 + (50–40) × .006 + (250 – 240) × .006) / (1 – .05 × 2) × (1– 0)) = ((2.59 + .06 + .06) / (.9 × 1) = 3.00.

With this equation, groups can be monitored and compared. Consider the following example. Is a F/G of 3.0 from another group of pigs fed milo-based diets without added fat from 60 to 260 pounds better or worse than the previous example of an observed F/G of 2.59 from a corn-soybean meal based diet with 5 percent added fat from 40 to 240 pounds? Using the equation indicates the group fed milo-based diets has an adjusted F/G of 2.82 due to the lower energy level of the milo, no added fat, and heavier starting and ending weight. This is lower than the adjusted F/G of 3.00 for the group fed the corn diets. Therefore, the group fed milo-based diets had a better biologic feed conversion and less feed wastage than the group fed corn-based diets.

These factors are used to adjust between groups to compare expected biologic performance among groups. Economics may dictate that feed cost may be less expensive for pigs fed a milo-based diet with no added fat compared to pigs fed a corn-based diet with added fat even though the group fed the milo diets has a higher F/G.

When examining cost per pound of gain in the finishing phase do feed processing charges have a big impact on cost?

Yes, accurate accounting of feed processing charges is necessary for accurate cost comparisons among different closeout groups. A processing charge of $12.50 per ton will add approximately $3.75 to the cost of producing a pig. This is equivalent to $0.019 per pound of gain. Similarly, a processing charge of $15 per ton will add $4.50 to the cost of producing a pig, which is equivalent to $0.022 per pound of gain.

Conclusion

Grower–finisher feeds represent the largest share of feed cost in on a farrow-to-finish operation. Therefore, decisions to change or modify finishing diets must be made based on economics. The advent of segregated and multi-site production resulting in large groups of similar age and weight pigs has resulted in more efficient feed deliveries, phase feeding, and split-sex feed-

Table 10. Feed Efficiency Targets (Equivalent to a Feed Efficiency of 3.0 from 50 to 250 pounds for a corn-soybean meal based diet with no added fat).

		Corn-based diets		Milo-based diets	
Entry Weight, lb	Market Weight, lb	0% Fat	5% Fat	0% Fat	5% Fat
		Meal Diets			
40	240	2.88	2.59	2.94	2.64
40	250	2.94	2.65	3.00	2.70
40	260	3.00	2.70	3.06	2.75
50	240	2.94	2.65	3.00	2.70
50	250	3.00	2.70	3.06	2.75
50	260	3.06	2.75	3.12	2.81
60	240	3.00	2.70	3.06	2.75
60	250	3.06	2.75	3.12	2.81
60	260	3.12	2.81	3.18	2.86
		Pelleted Diets			
40	240	2.71	2.44	2.76	2.49
40	250	2.76	2.49	2.82	2.54
40	260	2.82	2.54	2.88	2.59
50	240	2.76	2.49	2.82	2.54
50	250	2.82	2.54	2.88	2.59
50	260	2.88	2.59	2.93	2.64
60	240	2.82	2.54	2.88	2.59
60	250	2.88	2.59	2.93	2.64
60	260	2.93	2.64	2.99	2.69

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