Latest Information on Nutrition of the Pig

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Introduction

The topic I was asked to address is the latest research on nutrition in the pig. Because there are so many potential topics that could be discussed, we have decided to concentrate on two main themes within each of the production areas in this paper. The first section within each production area will briefly review the basic areas that must be considered in designing a nutritional program. The second section will highlight a few of the new, interesting areas of research within each production area.

Nursery

A successful nursery feeding program contains several components, but the most important are: A) Start with as heavy and as old of pig as feasible; B) Feed as simple of diets as possible; and C) Provide the proper management to start pigs promptly on feed and water and continually adjust feeders to optimize feed efficiency.

Recent Kansas State University research has shown that increasing weaning age through 21 days linearly increases growth rate and reduces mortality from weaning to market. In these studies, wean-to-finish growth performance and productivity (as measured by ADG, mortality, off-test weight per day of age, and weight sold per pig weaned) improved as weaning age increased from 12 to 21 and 15.5 to 21.5 day of age. Linear improvements in growth and mortality rate largely occurred in the initial 42 d post-weaning period, with some ongoing growth improvements in finishing performance. These studies suggest increasing weaning age up to 21.5 d can be an effective production strategy to improve wean-to-finish growth performance in a multi-site production system.

The keys in diet formulation are remembering that: 1) feed intake drives growth performance; 2) complex diets with specialty ingredients increase feed intake during first few weeks after weaning; 3) diet complexity must be reduced rapidly as the impact on feed intake declines. Common mistakes in nursery diet formulation include: 1) selecting ingredients that are highly digestible, but not highly palatable; 2) using whey or protein sources that are not high quality; 3) using high fiber ingredients in nursery diets in an attempt to help gut health; and 4) feeding complex, expensive diets too long.

The best nursery diets cannot overcome poor management. When pigs enter the nursery, they should have continual access to feed and water. Techniques, such as dripping water from cups or nipples, or gruel feeding, should be used during the first few days after weaning to encourage feed and water consumption. After pigs have started on feed, feeders need to be adjusted frequently to minimize wastage to achieve excellent feed efficiency. The most common feed management problems in nurseries are: 1) not making feed and water easy for the pigs to find after weaning; 2) treating starve-out pigs with antibiotic

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injections instead of helping them find feed and water; and 3) having too much feed in feed pans leading to spoiled and wasted feed.

New Nutrition Ideas for Nursery Pigs

Management aids for starting weaned pigs on feed. Even though weaning age has increased, producers continue to struggle with getting all pigs started on feed promptly after weaning. Thus, numerous products have been introduced to the market in the last few years ranging from gels that can be used for gruel feeding to intensive care feeders that automatically feed gruel on a timed schedule to encourage pigs to continue pre-weaning feeding behavior. Although there is not much solid research on their benefit, several producers have reported lowering pig mortality and starve-out rate with these tools. It is important to realize that these tools take a high degree of intense management to use properly and to avoid wasted cost.

Reduction in nursery diet phases. As weaning age has increased, a trend that has begun is to decrease the number of dietary phases provided immediately after weaning. The first and second diets fed after weaning are being combined into one diet, similar to the three-phase program that existed before the advent of segregated early weaning.

Testing of growth-promoter antibiotics. We have conducted several trials recently that have demonstrated that the antibiotic providing the greatest and most economical growth promotion will vary between production systems and may vary over time. These trials have demonstrated the need to evaluate responses to growth promoters within the particular production system over time to determine which antibiotic is providing the most economical response.

Mixing efficiency. We have long believed that proper mixing of diets was important; however, little data was available to quantify the benefit. Also, diets contain a higher number of low inclusion rate products, such as synthetic amino acids, zinc oxide, antibiotics, or Paylean, than in the past. Crystal Groesbeck, one of our graduate students, recently completed a trial demonstrating the importance of achieving complete mixing with nursery diets. In her trials, ADG and F/G improved linearly by 8 to 25% as coefficient of variation was reduced to the optimal level of less than 10% with adequate mixing.

Wean-to-finish barns. Although not nutrition topics, the two greatest nursery trends in the U.S. currently are the increase in weaning age and the increased use of wean-to-finish barns. Very few nurseries will be built in the future. New construction will almost entirely be based on the wean-to-finish concept.

Grow-finish pigs

Similar to the nursery, diet formulation is just one component of the grow-finish nutrition program. The diet formulation keys in the finisher are to: 1) determine the most economical energy level; 2) determine the lysine:calorie ratio to use for the genetics and production situation; 3) determine the ratio for the other amino acids; 4) determine the available

phosphorus level; and 5) set levels of vitamins, trace minerals, calcium, salt, and other ingredients.

Determining the optimal energy level will depend on many criteria including the relative cost of grains, fat sources, and byproducts. Another criterion that must be considered is the relative importance and value of ADG and impact of energy level on growth rate in the production situation. If growth rate is improved by increasing the dietary energy level, margin over feed cost should dictate the correct energy level in the diet instead of feed cost per unit of gain. In many situations, increasing dietary energy will increase ADG, but it will also increase feed cost per unit of gain. If ample facility space is available, such that pigs will reach the optimal market weight before they must exit the building, optimal feed cost per unit of gain should dictate the energy level. However, if facility space is not available to allow pigs to reach the optimal market weight, margin over feed should dictate the optimal energy level. In most production systems, adequate facility space is not available during the hot summer months. Thus, dietary energy levels higher than those required to minimize feed cost are often economical.

Similar to the nursery, feeder management is critical to minimizing feed wastage and optimizing feed efficiency. Fine grinding to have particle size of 700 microns or less also improves feed efficiency with most grains. Reducing variability in particle size is the key to maintaining diet flow ability when feeding mash feed with particle size less than 700 microns. We have observed greater flow ability of grain ground with a rollermill compared to that ground with a hammermill. When fine grinding meal diets with high levels of added fat, it may be essential that a roller mill be used. Recent studies at Kansas State University have shown that roller mill ground corn with 6% added fat will have similar flow ability as hammer mill ground corn with no added fat.

The most common mistakes in grow-finish nutrition programs are: 1) not understanding the production or economic response to changing dietary energy levels in the particular production system; 2) not matching the lysine levels to the energy levels; 3) providing more additives and micronutrients than required; 4) not using a small enough particle size; 5) not always having feed available in the feeders; and 6) not adjusting feeders aggressively.

New Nutrition Ideas for Grow-Finish Pigs

Energy to drive ADG for lightest pigs. Because increasing dietary energy often results in linear improvements in ADG of grow-finish pigs under field conditions, we tested whether pigs could be sorted by weight to feed higher energy diets to the lightest 50% of the pigs in the barn and lower energy diets to the heaviest 50%. The results of these trials indicated that the concept works and that light pigs actually have a slightly greater response to energy than the heavier pigs. Thus, one method to reduce final weight variation in a barn is to feed higher energy diets to the light pigs in the barn. If the barn is equipped with two feed lines, initial economic results indicate that a greater benefit will be gained by splitting the barn based on weight instead of sex. Of course, the difficulty is that diets with different energy density will have to be manufactured and provided to the two groups.

Fat withdrawal. Because the economics to adding dietary fat change over the course of the finishing period, dietary fat is often used at higher levels in the grower diet and removed from the diet after approximately 90 kg. Previous research at Kansas State University by De La Llata indicated that some positive carryover effects may occur when fat is removed from the diet. Recent trials are not as clear. In some of the experiments, removing all the added dietary fat resulted in a negative impact on subsequent ADFI and ADG. It appears that the impact of added dietary fat on feed efficiency is very clear and doesn't depend upon previous nutrition level. However, the response in ADFI and ADG is more variable and depends on the genetics and production situation. The lowest risk approach when using added dietary fat is to reduce the level more gradually if economics dictate that it should be removed from the diet.

Dried distillers grain with solubles (DDGS). The use of DDGS in swine diets has increased greatly in recent years. Along with others, we have conducted numerous trials with DDGS. Our general summary on DDGS is as follows:

1) DDGS appear to have similar energy (or slightly higher) than corn, so ME value is often not a problem.
2) DDGS lysine availability is variable, but can be dealt with in formulation.
3) When given a choice, pigs prefer to eat a diet that does not contain DDGS
   a) The negative effect on choice increases linearly as DDGS level increases in the diet
   b) The preference does not change with time on feed
   c) The negative effect can not be masked with sweeteners
4) When not given a choice, feed intake is reduced linearly as DDGS level increases in the diet
   a) Most field trials that we have conducted show the linear response in reduced ADFI
   b) At 10%, the reduction isn't great, but it is evident, and it is economically important
   c) The linear reduction in ADFI leads to a linear reduction in ADG and decreased margin over feed
5) If an individual plant that can be identified that is field tested to not have the negative impact on feed intake and the DDGS can consistently be sourced from that plant, DDGS can be an economical ingredient
   a) Many producers are not able to source DDGS from a single plant or don't have the ability to test the source in growth trials
6) If DDGS are being added for therapeutic reasons, they should be evaluated similar to the way that an antimicrobial would be evaluated with understanding of the reduction in mortality and/or medication cost required to offset any potential decreased margin due to using the DDGS in the diet. The trouble is that defining the amount of therapeutic benefit that is received from DDGS is extremely difficult. Using this approach, the system at least knows how much mortality and medication cost would have to be reduced to pay for the use of DDGS.

Paylean withdrawal. Paylean is a very useful tool that provides an additional 2.5 to 4 kg of weight gain when fed during the last 21 days before market. When finishing barns are closed out, there are often pigs that have not reached the ideal market weight.

These pigs are often moved to an "opportunity" barn for an additional 4 to 6 weeks before marketing. Depending on the production system, the lightweight pigs are either kept on Paylean or switched to a diet with no Paylean until marketing. We conducted a series of experiments to examine growth performance of pigs fed different Paylean regimens and to develop recommendations on how to effectively manage Paylean use in lightweight pigs. Feeding Paylean and then withdrawing it for a period of time did not improve or reduce overall performance. Re-feeding Paylean after the withdrawal period resulted in the same overall performance as pigs that only received Paylean for the last 21 days prior to market. Therefore, If pigs must be fed Paylean for a longer period (ex. light pigs moved to another barn), they should be fed a diet without Paylean until they are 21 days from being marketed. At this time, they should be put back on the Paylean diet.

Sows

The goals of the gestation feeding program are relatively simple. They are to prepare sows to be in proper body condition at farrowing and to meet daily nutrient requirements at the lowest cost possible. The cost of the gestation program should be evaluated on a cost per sow per day basis instead of cost per ton because dietary energy levels will greatly influence daily feed requirements. Although the goal of having sows in the proper body condition at farrowing is simply, it is hard for producers to consistently do on the farm.

The most important aspects of the feeding program for lactating sows are to maximize energy intake and to match the nutrient levels to the level of feed intake and sow productivity. The science of feeding lactating sows, such as the optimal lysine level and litter and reproductive response to changes in dietary intake, are well established. The difficulty is achieving the goals of maximal intake during lactation.

The most common sow diet formulation problems are: 1) selecting gestation dietary energy level by cost per ton instead of cost per sow per day; 2) using expensive fat sources; 3) using expensive additives without solid data; 3) over-formulation of gestation diets and under-formulation of lactation diets; 4) using ingredients with variable quality in lactation diets; and 5) synthetic amino acids in lactation and gestation diets. The most common sow feed management problems are: 1) over-feeding sows in gestation; and 2) under-feeding sows in lactation.

New Nutrition Ideas for Sows

Feeding levels for gestating sows. The feed requirements of gestating sows are determined by their body weight (maintenance) and desired level of weight gain. Our research has demonstrated that a flank-to-flank measurement and ultrasound backfat can be used to accurately set feeding levels to minimize the number of over-conditioned sows at farrowing. Details on the feeding method are available at our website: http://www.oznet.ksu.edu/dp_ansi/swine/gestationfeedingtools.htm

Feeding group housed sows. We are in the middle of experiments to test a feeding method that has been developed by Dr. Steve Henry in conjunction with some Kansas producers. They started feeding group-housed sows multiple times per day with three feedings grouped together in the morning (Ex. 8:00, 8:30, and 9:00) and three feedings grouped in the afternoon (Ex. 15:00, 15:30, and 16:00). The producers have reported less fighting and less variability in body condition as compared to once or twice per day feeding. There are some biological reasons that the feeding pattern may make sense. In some of our research with carnitine and chromium, we found that the insulin spike that occurs immediately after a meal takes between 2 and 3 hours to return to baseline. It is possible that the sows that eat most of the initial meal is experiencing the postprandial insulin rise and does not experience as much hunger when the second and third meals are dropped. We are currently completing field trials to verify this response.

Ad lib lactation sow feeders. Several ad lib sow feeders have become available in recent years. These feeders are gaining in popularity both because of decreased labor and because they have been proven to result in higher lactation feed intake than hand-fed systems. A new innovation in these systems is a feeder that can be mounted to existing farrowing stalls that offers a controlled release of feed when the sow manipulates the ball at the bottom of the feed drop. The feed hopper can be filled daily or be attached to a feed line for automated feeding. The Berry Feeding System is the first of these systems on the market. Several of these types of feeders are expected to be marketed soon.

Conclusion

There are several new nutrition ideas that will help increase profit and/or decrease cost; however, we must always remember the basics that have the greatest impact on the profitability of the nutritional program.