

Basic Research - Does It Benefit Kentucky Swine Producers?

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An area of frequent discussion in the swine industry (within both academia and industry circles) is the value of swine research. Some research groups have established strong basic research programs while others are actively involved in applied research. Occasionally the discussion turns into a debate on which type of research is most beneficial to the industry.

Basic vs Applied Research - What's the Difference?

First, let's define what is meant by "basic" and "applied" research. Does "basic" mean laboratory bench research while "applied" means pig feeding trials? Not necessarily. The first thing that we must realize is that these terms often have different meanings to different people. An area that may seem to be very applied to a scientist may seem to be very basic to a swine producer. And, in fact, basic research to one scientist may be viewed as rather applied research to another scientist.

In the scientific community, basic research is often regarded as "discovery" research. In the nutrition area, it is a study of the mechanisms of how various nutrients and other compounds are utilized by animals, how they are metabolized for production of various body tissues (muscle and fat growth, pregnancy, milk production, etc.), and how they interact with each other and with other factors such as genetics, environment, etc. Basic research in this area leads to the discovery of new knowledge that eventually filters down to applied levels. The thought is that if the mechanism of action is understood, the nutritionist can then use other nutrients, compounds, or management strategies to favorably exploit the situation.

On the other hand, applied nutrition research is the application of new scientific knowledge to the practical aspects of nutrition and feeding. Applied research can be rather fundamental in nature, or it can be very practical where application is immediate to swine producers. Often it is somewhere in between the two.

Both basic and applied research are important, and one cannot exist without the other. New technology in the swine industry first must originate from basic findings, then it must be tested, and finally it must be applied at the producer level.

An important difference in the two types of research is the amount of time that it takes for new and applied information to filter down to the producer level where it can be used in the production of pigs. Basic research discoveries often take many years of intensive study before producers have opportunity to use them. Applied research, however, often has immediate application to swine production at the farm level.

Swine producers often are not aware of the impact that basic research discoveries may eventually have on their production efficiency. Often, discoveries have fairly direct application to the pharmaceutical or feed industries, and those new technologies then eventually filter down to producers. For example, new sources or combinations of amino acids, vitamins, minerals, and/or additives may quickly be adopted by ingredient suppliers and feed manufacturers and be incorporated into their

products (e.g., supplements, base mixes, premixes) that will increase producers' production efficiency without the producer even being aware of the new technology.

Where do research teams at universities like the University of Kentucky fit into the total research picture? The allied industries that support the swine industry (such as feed dealers, vitamin and mineral suppliers, feed additive companies, and equipment manufacturers) rely on universities to do basic research. Many of these industry groups feel that they can do the more applied studies once the basic work has been done. While the primary role of universities may, in fact, be to do basic research, it is also important that universities participate in application of those principles in order to remove any bias (or perceived bias) that might be associated with strict industry research where firms have a vested financial interest in the outcome of the research.

Basic Research in Swine Nutrition at UK

The swine nutrition group at the University of Kentucky has been involved in a number of basic, "discovery" research areas in the past 25 years. A partial listing of those areas and the contributions that our group has made are as follows:

Antibiotics. Some of the initial evaluation of new antibiotics were done at the University of Kentucky. Long before Stafac®, Mecadox®, and Denagard® were approved by the Food and Drug Administration (FDA) for use in pigs, studies were conducted to evaluate their efficacy under various conditions. We have also done basic research on other compounds that have not yet been approved by the FDA. Often, approval takes 10 or more years from the initial studies. Perhaps some of those drugs will be approved in the future.

The basic research studies on antibiotic resistance that Dr. Virgil Hays initiated in the early 1970's was very instrumental in identifying the factors that cause and do not cause antibiotic resistance in pigs. This research, which is still ongoing, was one of the key factors responsible for the fact that we still have penicillin and the tetracyclines (Aureomycin®, Terramycin®, Aureo SP-250®, Aureomix-500®, etc.) available for use in the swine industry. At the time this research started, many thought it was not important; but without his foresight, the industry may have suffered a great loss of very useful products.

UK also played a key role in saving the sulfonamides for swine use. In the mid and late 70's, incidence of sulfa residues in pigs was high and FDA threatened to ban them if the residue problem wasn't corrected. Studies at UK identified the reason for the residues problem as being primarily cross-contamination of finishing feeds with sulfamethazine that resided in feed mixing and handling equipment following mixing of sulfamethazine feeds. Our findings paved the way for correcting the problem and virtually eliminating the residue problem today.

Copper. UK was among the first to discover the growth enhancement of high dietary levels of copper sulfate (250 ppm copper) for weanling pigs. Our group was responsible for discovering the major boost in growth that occurs when both copper sulfate and antibiotics are added together to starter diets. Today, copper is used in nearly all starter feeds. Incidentally, our finding that the copper in copper oxide is unavailable to pigs was not previously known. At that time, the oxide form was the most common copper source in trace mineral mixes. Obviously, today it is not. Also, our recent studies showing copper chloride to be equivalent to copper sulfate has resulted in a major shift to this

less reactive type of copper in trace mineral-vitamin base mixes.

Carcass Enhancers. Some of the first basic studies on porcine somatotropin (growth hormone), cimaterol and ractopamine (beta agonists), and chromium picolinate, and the impact of these carcass enhancers on nutritional requirements were conducted at UK. Except for chromium, these compounds are not yet approved by the FDA, but some of them eventually may be. Our research with chromium was in progress for 5 years before its approval in January, 1996.

Starter Diets for Early Weaned Pigs. Early weaning of pigs is becoming increasingly popular. Years ago, we conducted some of the early studies on the efficacy of dried whey and lactose in improving the nutritive value of starter diets for early weaned pigs. More recently, our basic studies on the immunoglobulin factors in dried plasma protein and enzymatically digested protein have led to their use in ultra-early weaned pig diets.

Bioavailability of Phosphorus. Our team was the first to assess the bioavailability of phosphorus in feeds commonly fed to pigs and to show that feedstuffs vary greatly in their bioavailability. Today, most feed manufactures formulate feeds on an "available phosphorus" basis, using information that we discovered at UK.

Feed Enzymes - Phytase. For years, nutritionists recognized that pigs cannot utilize organically-bound phosphorus (phytate) in grains and oilseed meals. UK was the first university in the USA to show that the phytase enzyme was very effective in degrading the phytate phosphorus in corn and soybean meal and making it available to pigs. Our initial studies conducted 7 years ago paved the way for the eventual approval of phytase in pig feeds in the USA. Natuphos®, a genetically engineered source of phytase, was approved by the FDA in November, 1995. Use of this enzyme allows producers to feed less inorganic phosphorus and helps to reduce the excretion of phosphorus in manure.

Protein and Amino Acid Requirements. Dr. Tim Stahly's research at UK in the early 1990's was the first to show a definite relationship between nutrition and genetics. This research clearly showed that pigs with high lean growth rate require higher dietary protein (lysine) levels to maximize leanness and grow efficiency than conventional pigs. UK also participated in regional studies that clearly showed that gilts require higher protein (lysine) levels than barrows. As a result, tailoring of diets to meet requirements for lean growth and separate-sex feeding is common today.

Additionally, UK is credited for the discovery that prolific sows nursing large litters of pigs produce more milk and lose less weight during lactation when fed high protein diets during lactation as compared with sows nursing conventional litters. This discovery has led to the now-commonly accepted practice of feeding prolific sows increased levels of dietary protein than previously recommended.

Environmentally Friendly Diets. The UK swine group was among the first to show that nitrogen and phosphorus excretion by pigs could be dramatically reduced by diet manipulation. We discovered that the use of low protein, amino acid supplemented diets and the use of phytase would reduce nitrogen and phosphorus excretion by up to 50%. Working with Dr. Larry Turner in Agricultural Engineering, we also found that low protein, amino acid supplemented diets markedly reduces ammonia emissions in pig manure. These types of discoveries have tremendous potential in regard to reducing odors and environmental pollution from pig production.

Early Weaning Sow Management. Years ago, we determined the impact of ultra-early weaning on reproductive efficiency of sows. Specifically, we found that breeding at first estrus following weaning at 2-13 days reduced conception rate and subsequent litter size. This information seemed of little value at that time because hardly anyone was weaning before 2 weeks. Today, 1-2 week weaning is common in most of the large integrated farms. Just like in those studies conducted 20 years ago, producers today are finding that it may pay to skip a heat following 1-2 week weaning unless they are willing to live with reduced conception rates and slightly reduced litter size.

Continued Basic Research at UK

In order for the University of Kentucky to continue to be actively involved in research that benefits swine producers in the Commonwealth and the nation, new research facilities are needed. We will soon be vacating our present swine research facilities on Coldstream Farm, and are actively planning new research facilities at the Woodford County Animal Research Farm. The new unit is designed to utilize modern technology in building arrangement and design to maximize health and minimize waste and odors, while allowing us to continue to do the basic research studies that will eventually lead to direct application of practices that benefit Kentucky swine producers.

Remember, basic research is much like baseball. There are a few strikeouts (we won't mention them) and a few home runs (like the antibiotic and copper sulfate discoveries), but mostly there are singles and doubles (like the new ingredient evaluations and other similar less prominent discoveries). Home runs are always exciting, but its usually the singles and doubles that make for a winning season.