Is the Diet Part of the Herd Health Program?

J. E. Pettigrew
University of Illinois

Maintaining pig herd health is a challenge under any circumstances. The veterinary profession has led the industry to adopt a range of sophisticated technologies as components of a comprehensive herd health program. These critical technologies include all-in/all-out pig flow, strict biosecurity measures, sanitation, vaccines, depop/repop, and others, and these have been enormously important. However, the challenge remains.

We have traditionally used antibiotics in the feed as an important component of herd health programs, and they continue to be important. There is now good evidence that addition of other products to feeds may also help to keep pigs in good health. In fact, we have available an impressive range of feed ingredients and technologies that are suggested to improve pig health. Some of these are ingredients included in the diet at levels high enough that they provide important amounts of energy and amino acids; key examples are spray-dried plasma, rice, milk products and fish meal. Others are low-inclusion additives such as mannan oligosaccharide, acids, probiotics, prebiotics and many others. There are also broader feed management and formulation issues including fermented liquid feeds and low-protein diets. Reasonable arguments can be offered to support the benefits of each of the proposed technologies, but most of them have not been adequately evaluated with sound research across a variety of situations.

This paper will discuss in more detail three of the feed ingredients proposed to improve health: spray-dried plasma, mannan oligosaccharide (MOS) and rice. Strong databases support practical advantages of plasma and MOS, although we're still learning about how they work and the range of situations in which they can be beneficial. Recent data from our laboratory support optimism that rice may contribute to pig health in significant measure, although our notions of how it may act are based largely on conjecture.

Spray-dried plasma

Spray-dried plasma is fed to nearly all weaned pigs in North America. Such widespread adoption of a product so expensive as this one is driven by the magnitude of the benefits. Two reviews of the relevant literature published several years ago show astounding increases in growth rate of about 25% when spray-dried plasma is fed to newly weaned pigs. Very few technologies in pig production produce effect this large. Our more recent review of studies not included in the earlier ones show about the same magnitude of response, suggesting the response is not diminishing over time. Our review also indicated that the size of the response after weaning is not related to weaning age, suggesting the product is as effective when pigs are weaned older as when they are weaned younger.

Several studies have shown that pigs grow more slowly after plasma is withdrawn from their diet than if they had never received plasma, raising the question of whether the benefit persists. The available data suggest that an important part of the benefit does persist.

We know surprisingly little about the mechanisms through which plasma improves performance. We do know that plasma contains immunoglobulins, other components of the immune system, and presumably other physiologically active compounds, and we presume some of them provide benefits. The connection to health management is shown clearly in several

studies in which pigs were experimentally challenged with pathogenic *E. coli* and those fed plasma had lower mortality rates than those not fed plasma.

Mannan oligosaccharide (MOS)

Mannan oligosaccharide is a more complex product than its name suggests, being a preparation of the outer layer of the cell wall of the yeast *Saccharomyces cerevisiae*. It is clear that it alters both the microbial populations in the digestive tract and the activity of the immune system, and that it improves growth rate of young pigs after weaning.

Enteric pathogens generally need to bind to the intestinal surface in order to proliferate and cause disease. Several common enteric pathogens of pigs, including many *E. coli* and *Salmonella*, bind to mannose units on the intestinal cells. Because of its mannose content, MOS binds to these bacteria. Theory holds that the binding of these bacteria to MOS in the digestive tract prevents their binding to the intestine, and therefore prevents their pathogenesis and proliferation to populations sufficient to cause disease. Our recent data confirm that feeding MOS alters microbial populations.

We have also contributed to the growing evidence that MOS affects the immune system. We took lung macrophage and stimulated them with LPS as a model of a bacterial infection. Pigs fed MOS produced less TNF-α (a proinflammatory cytokine) than did those not fed MOS. Similarly, adding MOS to the culture medium reduced the TNF-α production of stimulated macrophage. We do not yet have a clear picture of how these and other changes in the immune system translate into improved disease resistance, but we're making progress.

We're encouraged by the repeated observation that feeding MOS to sows improves the preweaning survival and growth rate of their piglets, an observation that directs attention to the impacts of MOS on the immune system.

Rice

Microbial populations in the lower digestive tract are likely to be heavily influenced by the substrate supply there, which in turn is largely a function of the type and amount of fiber in the diet. Our data confirm that changing cereals in the diets of young pigs changes microbial populations. A series of challenge studies from Australia has consistently shown that a rice-based diet very low in fiber protects against enteric diseases, and that addition of soluble fibers makes pigs more susceptible. Our *E. coli* challenge study also showed milder clinical signs when pigs were fed rice (the lowest-fiber diet) than when fed maize, barley or oat groats. A series of 3 experiments on a commercial farm in Illinois showed in every case that the number of pig removals (deaths plus sick or unthrifty pigs) was only half as large in pigs fed rice as in pigs fed maize. This occurred even when rice was fed for only the first week postweaning, while most of the removals occurred later.

Further confirmation of this apparent benefit of rice is now required, along with elucidation of its mechanism. The benefit may be caused by a specific physiologically active compound in rice rather than simply by the low fiber level.

Summary

Several feed technologies now available may contribute importantly to a herd health program. The examples discussed herein are spray-dried plasma, mannan oligosaccharide and rice.