

# Digestive aids: A brave new world of nutrition

Feed additives like probiotics, prebiotics and enzymes can improve broiler and turkey performance when incorporated into typical industry growing programmes, especially where maize-soybean diets are used.

Terrence O'Keefe

Feed cost is the largest single expense incurred in the broiler business, so lowering feed conversion is a major goal. Minimising feed conversion, however, will not necessarily give operations lowest total live cost. Because of this, poultry nutritionists and veterinarians are always looking for feed ingredients or additives that will help birds thrive under industry standard growing conditions and thus lower total cost.

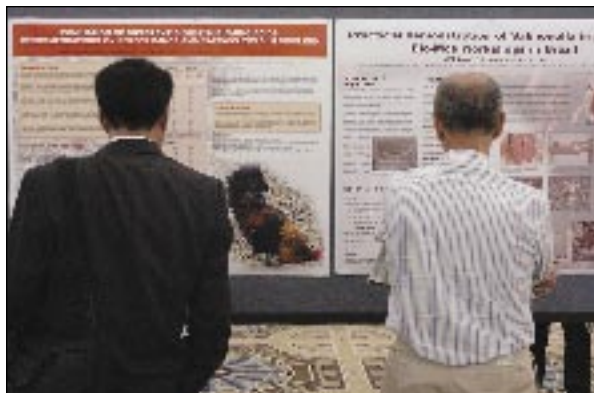
There is a dizzying array of products available to the poultry industry to help promote gut health and improve bird performance under field conditions. The most commonly used compounds are antibiotics and anticoccidials but there are several other types of products now available. Some of these have been developed for use with antibiotic-free or organic production but others aimed at improving health and digestion with standard industry diets and management practices.

Probiotics, prebiotics, essential oils and herbs, enzymes, immune modulators and organic acids are all being marketed for use in poultry to improve health and performance and to improve food safety.

Commenting on how these products are viewed by poultry industry professionals, Dr Daniel Hooge, consulting nutritionist, said, "There is a lot of interest but still a lot of scepticism about these products."

Some of the scepticism surrounding these products depends on how their use is evaluated. "Success is subjective because performance depends on a lot of factors," said Dr Peter Ferket, poultry science professor at North Carolina State University and consulting nutritionist. Sometimes pen trials will not show an effect but field trials will, he explained, because the conditions that the compound protects against or improves are not found in a clean university research setting.

He added, "Everybody assumes that putting antibiotics in the feed will give results but in the



Viewing posters at an Alltech Symposium

studies in the literature only two-thirds show a positive response to antibiotics. You get the same type of results with some of the alternatives. Under commercial conditions, the birds are challenged in different ways on different farms. Antibiotics are a good cover-all for mistakes.

Now, managers have to decide what kind of problems exist, and then pick the tool that addresses these problems effectively."

## Probiotics

Beneficial gut bacteria can provide birds with nutrients, vitamins, amino acids and volatile fatty acids. In Nature, the hatchling picks up the normal intestinal bacteria from its environment.

Probiotics are beneficial micro-organisms that are fed to the animal. They are antagonists of putrefying and ammonifying bacteria, which are usually found in the large intestine. *Lactobacillus*, a common probiotic, has an immuno-stimulatory action, which increases phagocytic activity and production of immunoglobins in the blood. Yeasts, particularly *Saccharomyces cerevisiae*, release mannan-oligosaccharides that bacteria tend to bind to and this reduces the number of bacteria that bind to the lining of the intestine of the bird. Probiotics can compete against pathogens for nutrients in the gut and for binding sites on the intestinal wall. Antibiotics change the intestinal microflora, and probiotic treatment will not be effective when antibiotics are used. Probiotic treatment can help restore and rejuvenate healthy microflora after antibiotic use.

Avi-Lution was developed using a *Salmonella typhimurium* challenge in mice by Prince Agri Products, Inc. It is a probiotic that contains lactic acid bacteria and live yeast. Avi-Lution Custom also has bacillus spores and yeast cell walls added. Dr Hooge reports that these products can both increase weight and lower feed conversion in poultry and that Avi-Lution Custom has been shown to reduce mortality.

Another probiotic is Calsporin, which is made from *Bacillus subtilis* C-3102. The product is made by Calpis

## Digestive aids

USA, Inc., and, according to Dr Hooge, has been shown to improve weight gain, feed conversion and mortality in poultry. *Bacillus subtilis* can pass through the intestine of the bird and live in the litter. He said that this can be helpful, since the bacillus reduces the number of clostridia in the litter.

Chr. Hansen produces BioPlus 2B, which incorporates two forms of bacillus. It was developed as a growth promoter for pigs but Dr Hooge reports that it is starting to be used with broilers in Europe.

Primalac is a combination product offered by Star Labs. It contains *Lactobacillus acidophilus*, *L. casei*, bifidobacteria and *Enterococcus faecium*. The product has been tested extensively in the USA for broilers and turkeys and has been on the market for several years.

Dr Hooge explained, "Probiotic products on the market are getting better and better. Eventually some product or products are going to break out and hit a homerun." Probiotics are usually put in the feed but can be administered in the water. He added that coating technology has improved and that microorganisms can survive feed pelleting nowadays.

## Prebiotics

Most prebiotics cannot be digested by monogastric animals, like poultry, but can be fermented by microbes in the gut of the bird. Examples of prebiotics are the carbohydrates oligo-fructose, fructo-oligosaccharides, mannan-oligosaccharides and inulin. Prebiotics may selectively enhance beneficial bacteria populations in the gut like bifidobacteria and lactobacilli. Some prebiotics, like fructo-oligosaccharides, are said to have a bifidogenic action. Bifidobacteria produce acetic acid, which has a bactericidal action.

Mannan-oligosaccharides are found in the cell wall of yeast. Each yeast cell wall can adsorb a couple of hundred *E. coli* cells. Mannan-oligosaccharide is the active ingredient in Bio-Mos, which is produced by Alltech. Dr Ferket, who has done feeding trials with Bio-Mos, said, "It may not work well with the first flock you use it, but there seems to be an additive effect over several flocks because it alters the microflora in the house as well as in the birds. Mannan oligosaccharides bind salmonella and *E. coli*, and reduce clostridial problems."

According to Dr Hooge, mannan-oligosaccharides can improve weight gain, feed conversion and liveability in broilers and turkeys. Dr Ferket explained that there is a glycoprotein structure on the yeast cell wall that is very similar to the glycoproteins on the intestinal lining of the birds, and the bacteria bind to the mannan-oligosaccharides instead on the intestine. He said that these bound bacteria seem to enhance the immune response because they are not killed and are antigenic even though they cannot infect the bird. Some of the other yeast cell wall materials, like beta-glucans, are antigenic as well and seem to stimulate a generalised immune response. Several companies market yeast and yeast cell wall products for use in poultry feeds. Live yeast is a probiotic but yeast cell

wall-based products are prebiotics.

## Enzymes

Enzymes are proteins that act as highly effective biological catalysts. Used in feed, they can increase the digestibility of nutrients and alter gut microflora. Enzyme use is now very common in poultry diets that contain wheat or barley. Dr Ferket said, "Enzymes are there to improve the utilisation of nutrients but now instead of just adding enzymes to improve utilisation, people are using them to reduce the formulation cost. In doing so, you sometimes see the added benefit of improved health and more resistance to certain types of disease."

In theory, the feed is more fully digested by the bird with the help of enzymes and the potential substrate for detrimental bacteria is instead used by the birds. Also, the enzymes will act on certain components of the diet that produce products of digestion that beneficial bacteria can use and cause a shift in the microflora towards a more healthy state. "I think you will see enzymes used to modify or control gut microflora for the good, both now and in the future. A lot of people are beginning to accept enzymes as feasible and favourable," he predicted.

"If you use an enzyme, the improvement in digestibility is pretty marginal. You might get a little better nutrient absorption, but the bigger thing is the change in microbial flora and better gut health," Dr Ferket said. An example is how enzymes can break down some non-starch polysaccharides like those found in wheat and barley and help promote growth of good bacteria. Without the enzyme, the indigestible fibre promotes the growth of 'bad' bacteria but with the enzyme, the fibre is broken down and promotes the growth of 'good' bacteria. With the addition of the enzyme, the indigestible starch works like a prebiotic.

Dr Ferket said, "Several turkey companies in the USA are now using enzymes in maize-soy diets and all of the companies use enzymes in such diets in Brazil. Enzymes generally work best if used in a low-energy diet. In the USA, we use high-energy diets because we have lots of inexpensive fat, so you do not see as big a benefit from the enzymes."

There are numerous enzymes on the market today. Prince Agri Products recently introduced Reap, an enzyme for improving starch digestibility. Allzyme Vegpro is marketed by Alltech. The active enzyme in Hemicell, from ChemGen Corporation, is beta-mannase, which breaks down the sticky carbohydrate portion of soybean meal. Soybean meal contains an anti-nutritive fibre, which inhibits the utilisation of feed by poultry. Beta-mannase degrades this fibre and improves feed efficiency. Rovabio from Adisseo contains both xylanase and beta glucanase. It can be used with maize-soy diets and also with those based on wheat. Danisco makes Avizyme 1502, which can be used to improve the digestibility of maize. Kemzyme, from Kemin, is a mixture of enzymes designed to improve the digestibility of all rations.

Phytase is an enzyme that allows poultry to utilise some of the organic phosphorus found in the grains in

## Digestive aids

their diets. It can decrease the need for supplemental inorganic phosphorus in the diet and will decrease the amount of phosphorus in the manure. Phytase can also provide the bird with additional amino acids and energy when it breaks down the organic molecules that bind the phosphorus in the feed. There are a number of companies that produce phytase enzymes for use in poultry diets.

### Glossary

**Competitive exclusion culture:** a subset of probiotics, but instead of providing the animal with one or a few bacterial species, a competitive exclusion culture attempts to provide a complete adult microbial population. The cultures can be defined or undefined.

**Enzyme:** proteins that assist in the degradation of feed constituents in the diet. The most common enzymes added to poultry diets aid in the digestion of complex carbohydrates, and include glucanase, cellulase, xylanase and glucoamylase.

**Essential oils and herbs:** herbs that contain antiviral or antibacterial compounds. Plants like oregano and garlic have been used to treat or prevent clostridial growth in poultry.

**Immune modulator:** enhances the action of the immune system, particularly in young poult or chicks. Spray-dried plasma, egg yolk antibodies, conjugated linoleic acid (CLA) and other compounds have been tried as feed-additive immune modulators.

**Organic and inorganic acids:** some research has shown that young animals, like poult and chicks, do not produce enough hydrochloric acid in the proventriculus to completely digest their feed. Organic acids added to the feed or water can aid digestion and can influence the microflora in the crop, which is located before the proventriculus in the gastrointestinal tract. Acid Lac, from Kemin, is an example of an acid mixture, which is made for incorporation in poultry feed. Acids in the feed can inhibit mould and bacteria growth and are commonly used as part of salmonella reduction programmes employed by primary breeders.

**Prebiotic:** indigestible food ingredients, usually carbohydrates, which beneficially affect the host by selectively stimulating the growth and /or activity of one or a limited number of bacteria in the colon.

**Probiotic:** a living microbial feed supplement, which beneficially affects the host animal by improving its intestinal balance. Probiotics are sometimes referred to as direct fed microbials or DFMs.

**Synbiotic:** the use of synergistic combinations of prebiotics and probiotics.

Dr Hooge said, "The original research was done in EU with wheat-based diets, and wheat has a natural phytase in it. So the same amount of phytase in a maize-soy diet releases less phosphorus into a form the bird can use, than it will in a wheat-based diet." Because of this, integrators using phytase in maize-soy diets have had to use more phytase to get the phosphorus reduction in the manure that they desire.

Perhaps one of the most unusual enzymes is Versazyme from Bioresources. Dr. Jason Shih, at North Carolina State University, was working on converting chicken litter to methane and found a bacteria, *Bacillus licheniformis*, which produces keratinase, an enzyme that can break down feathers. Versazyme contains this keratinase, and it improves the digestibility of all types of protein.

It is not always easy evaluating how effective probiotics, prebiotics, enzymes and other feed additives are. Dr Hooge said, "If there is a nutritional effect of these products, birds will do better in pen trials but if it is a health effect, the birds will not do better than the controls in pen trials." This same type of benefit can be seen with antibiotics as well, according to Dr Hooge. "The higher the density at which birds are raised, the better the response is to both antibiotics and probiotics. We are covering some management and crowding deficiencies. And we are compensating for no clean-outs and short downtimes," he said.

Dr Ferket explained that, to properly evaluate a feed additive, one needs to ask questions. "Understand the mode of action of the product. If someone comes to you and says that they can give you three points better feed conversion, then challenge them, and ask why or how it does that. Once the company nutritionist understands how the product works, he can devise his own combination of products that work best for his system," he said.

Dr Hooge said, "Use of these products will increase, even if we maintain availability of antibiotics for the industry." Dr Ferket added, "Use and acceptance of all of these compounds will grow. The more we understand how these substances work, the better we will be able to use them."

— Terrence O'Keefe, *Watt Agribusiness Media*. This article was first published in *Watt Poultry USA*.

*Editor's note: This article is based on symposium presentations giving examples of the products available in the USA. The current issue of 'Who's Who International' offers an extensive list of the many companies that supply products of the types mentioned in the article in international markets. The listing includes full contact details for each company. The publication, also from Watt Publishing, has recently been mailed to all subscribers of 'Poultry International'.*

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