Feedstuffs
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Feed supplements may fight salmonella

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HERE'S a way some researchers suggest to reduce salmonella in poultry before they go to the processing plant: Use probiotics for treatment of the birds.

It has been a complex path getting to this point, and the procedure still raises some other issues to be considered. Still, the development offers a way that makes it easy on poultry growers and enhances food safety.

It's a matter of incorporating the probiotic into either the water or the feed for the poultry, explained Billy Hargis, director of the Poultry Health Research Laboratory at the University of Arkansas System's Division of Agriculture. Results from experiments show that administration of a probiotic can reduce salmonella in either meat-type chicken houses or turkey houses before being transported to the processing plant and reduce the risk of cross-contamination among turkeys at the plant.

"It's not a chemical," explained Hargis, who conducted the research for the Food Safety Consortium. "These (probiotics) are live organisms."

One probiotic developed in Hargis' lab is FM-B11, a defined lactic acid bacterial culture. Defined cultures eliminate the risk of pathogenic organisms existing within the culture, clearing the way for their effective use in stopping salmonella in commercial poultry.

"Another advantage is that we're talking about organisms that can be produced very cheaply, which keeps the costs of these treatments very low," Hargis said. That's partly because the defined cultures from which the probiotics come are tolerant of oxygen, avoiding the high cost of fermenting undefined cultures that can't grow in the presence of oxygen.

Explaining that antibiotics have long been popular among poultry producers seeking to keep their birds healthy and to promote the birds' growth, Hargis said, "The risk factor for antibiotic resistance from food-producing animals is exceedingly low," but the issue is still becoming a driving force that's putting poultry producers under pressure to use fewer antibiotics.

More recent efforts are directed toward beneficial *Bacillus* bacteria. During the last year, a substantial laboratory effort has been directed toward identifying organisms of this genus that are harmless to animals or humans, inhibit certain pathogenic organisms and can produce spores that are resistant to heating or storage.

The important part of the new effort is to develop effective probiotics that can be added to feed, which greatly reduces costs associated with delivery in the drinking water at the farm.

"We can add these to the feed even before pelleting," Hargis said. "The beneficial bacteria in the feed have tremendous advantages because now we can talk about continuous administration over time. It makes it very simple. It just comes in with the feed."

"We're using (the probiotic) to prevent problems continuously as opposed to treating problems when they occur," Hargis said.

One of the other issues Hargis noted was that without antibiotic growth promoters, more feed will be

required to produce the same amount of chicken, and that increased amount of feed will require more acres of cropland to be planted.

Perfect storm

Indeed, in a presentation to the Kemin Poultry Summit held at the recent International Poultry Expo, Hargis said a number of current issues have created "the perfect storm" for gut health issues, and modifying the gut microbiota of chickens can have "tremendous paybacks."

He pointed out that probiotics are biological and need to be administered alive in a sufficient dose to be successful, and this is not foolproof.

In describing a potential mechanism for probiotics, Hargis noted that beneficial bacteria generate short-chain fatty acids that have "tremendous biological activity" as an energy source for enterocites (immune system), for increasing blood flow, regulating intestinal motility, increasing epithelial cell proliferation, decreasing pH and optimizing mucin production.

After summarizing several research projects on the role of probiotics in intestinal health, Hargis reported that data have indicated that the selection of efficacious probiotic cultures with marked performance benefits "is possible."

Specifically, many of the probiotics under commercial development are spore formers, such as *Bacillus*, which he said have been shown to prevent gastrointestinal disorders.

Spore formers are quite stable, allowing their use in pellets, but they require large doses (often 10^6 colony-forming units [CFU] per gram) that often need to be continuously added to feed.

Thermostability

As an example of Bacillus stability, Kemin Industries researchers S. Moore and Y. Lao presented an abstract (M2) at the International Poultry Science Forum on the thermostability of a new *Bacillus subtilis* PB6 strain.

Moore and Lao said two studies were conducted at Kansas State University to evaluate the thermotolerance of the proprietary/patented microorganism when exposed to challenges encountered during commercial pelleting processes.

Mash feed was inoculated with PB6 to attain a concentration of 10^{10} spores per ton of feed. Two studies using treatment by temperature factorial designs were then conducted in triplicate. In study 1, mash feed was exposed to conditioner temperatures set at 70, 80 or 90 degrees C prior to pelleting. In study 2, conditioned feed (82 degrees C) was processed through an annular gap expander prior to pelleting.

Thermotolerance was determined via a plate count method incorporating measures selective for *Bacillus* sp. recovery. In both studies, differences were observed between non-inoculated and inoculated mash feed ($P < 0.05$, study 1; $P < 0.001$, study 2), verifying that the targeted levels of PB6 were achieved.

In study 1, Moore and Lao said hot pellet temperatures ranged from 78.8 to 89.1 degrees C, and in study 2, hot pellet temperatures ranged from 92.8 to 98.3 degrees C.

As temperatures increased, they reported that survivability of the organism decreased ($P < 0.001$, study 1; $P < 0.05$, study 2).

While biological systems are inherently variable, Moore and Lao said it can be generalized that, when hot pellet temperatures reach greater than 90 degrees C, there is a statistical probability that a minimum of

1 log of microorganisms will be lost. The results of this expander study closely paralleled previous work where similar losses were observed under commercial expander/pelleting conditions, Moore and Lao concluded.

Other tools, conditions

In the commercial poultry industry, there are many management tools used to control enteric pathogens, including antibiotics, vaccines, prebiotics and competitive exclusion cultures, J.L. McReynolds, J.A. Byrd and D.J. Nisbet of the U.S. Department of Agriculture-Agricultural Research Service (ARS) and R. Beltran of Biomin USA Inc. said in abstract T109 at the International Poultry Science Forum.

McReynolds et al. said their laboratory -- the Food & Feed Safety Research Unit -- is interested in using these products to control *Clostridium perfringens* (CP), a Gram-positive organism associated with lower levels of performance and health that has been implicated in necrotic enteritis.

They presented the results of an investigation that evaluated a probiotic culture (Biomin PoultryStar) and a phytogenetic product that were administered to birds from day of hatch until termination (day 25) via the drinking water or through a wheat/corn diet, respectively.

Birds were administered CP (10^7 CFU/mL) daily via oral gavage for three consecutive days starting on day 17.

When evaluating the intestinal lesions, mortality and $\log_{10}$ values of CP, birds in the probiotic and phytogenetic treatment groups were significantly lower ($P < 0.05$) than the controls, McReynolds et al. reported. The $\log_{10}$ values of CP were not significantly reduced in the phytogenetic treatment group.

These experiments suggest that this probiotic culture and phytogenetic product could be used as a potential alternative to help control CP infections and necrotic enteritis.

Excess chicken fat

Obesity is a problem for many American consumers, and now even chickens are getting fat. As a result, ARS scientists have been looking for ways to help growers efficiently produce chickens of optimal weight while minimizing excess fat.

At the ARS Animal Biosciences & Biotechnology Laboratory in Beltsville, Md., animal scientists Monika Proszkowiec-Weglarz and Mark Richards, along with research leader John McMurtry and Penn State University collaborator Ramesh Ramachandran, recently identified and sequenced genes responsible for regulating both energy use by individual cells and the food intake of birds. They also showed that the genes function in different tissues throughout the body of the broiler chicken.

This important biochemical pathway, previously discovered in other animals, maintains energy balance in the bird's body. A key component of the pathway is an enzyme called AMP-activated protein kinase (AMPK).

In all animals, obesity results from an imbalance that occurs when more food energy (calories) is consumed than the body actually needs. The excess energy is stored mostly as fat.

Over the years, in response to a growing worldwide consumer demand, poultry breeders have bred chickens that grow faster and produce more meat. However, modern broiler/breeder chickens don't adequately balance their feed consumption to match their energy requirements. When these birds are given unrestricted access to feed, they will overeat and become obese.

AMPK plays a central role in sensing cellular energy levels. It begins a series of events that affect food intake and metabolism of fat, carbohydrate and protein. According to Proszkowiec-Weglarz, AMPK is really a "molecular fuel gauge" and a master metabolic regulator in cells. It responds to fluctuations in the levels of cellular energy and of specific nutrients and hormones outside the cells.