INNOVATIONS AND PRACTICAL ADVICE FOR SUCCESSFUL FLOCK CARE

POULTRY HEALTH TODAY

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THE CASE FOR IONOPHORES

How they're different from other antibiotics — and why it matters

US EDITION

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INNOVATIONS AND PRACTICAL ADVICE FOR SUCCESSFUL FLOCK CARE

POULTRY HEALTH TODAY

WHAT'S INSIDE

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40

Pounds of feed a single rat can eat in a year, which is equivalent to the amount consumed by four 5-pound broilers

SOURCE: AUBURN UNIVERSITY, *THEPOULTRYSITE DIGITAL*, MAY 2015

> Just because ammonia levels are acceptable during the day doesn't necessarily mean that there aren't potentially harmful levels at night.

MICHAEL CZARICK, UNIVERSITY OF GEORGIA, *POULTRY INFORMED PROFESSIONAL*, MARCH/APRIL 2015

> It's kind of like losing weight. It's simple but not that easy.

CARL HEEDER, DVM, ZOETIS INC., DISCUSSING THE CHALLENGES OF MAINTAINING GOOD, DAY-TO-DAY BIOSECURITY ON BUSY POULTRY FARMS

12.83 million

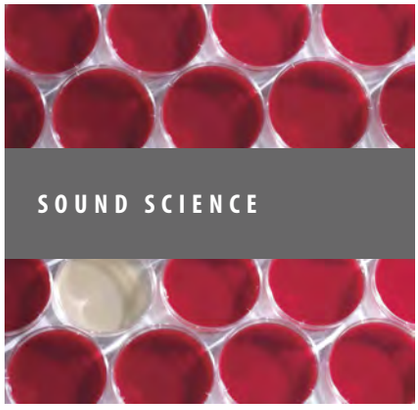
Number of chickens sold in 1919 in Illinois — the top poultry state in the US at the time. Total US production that year was 140.8 million. Compare that to 9 billion chickens today. SOURCE: USDA HANDBOOK OF POULTRY & EGG STATISTICS, 1933

842

Number of antibiotic prescriptions per 1,000 Americans in 2011. For people 0-9 and over 65, rates actually exceeded 1,000 prescriptions per 1,000 people. Amoxicillin was the most commonly prescribed antibiotic in children and teenagers while azithromycin was No. 1 with adults. SOURCE: CDC, *CLINICAL INFECTIOUS DISEASES*, VOL. 60, NO. 9

> Sustainability is actually quite simple. It's about continuous improvement. It's about understanding what our priorities are and getting better at the things that matter…we've been doing that in agriculture for a couple of hundred years.

MARTY MATLOCK, PHD, OFFICE OF SUSTAINABILITY, UNIVERSITY OF ARKANSAS



...choosing eggs solely on the basis of the production system may not be enough to guarantee superior quality...

Alternative eggs not necessarily better quality

Eggs from alternative production systems aren't necessarily superior in quality to commercially produced eggs, researchers from the University of Lisbon said at the 2015 International Poultry Scientific Forum.[1]

The researchers obtained and tested 144 commercially available eggs from six different production systems: free-range organic with indigenous breed, free-range organic, free-range, cage-free and cage systems with and without omega-3 essential fatty acid supplementation.

The percentage of albumen in relation to the whole egg was higher ($p < 0.05$) in both free-range organic systems compared to other groups. Eggs from caged hens had a lower Haugh unit value — a measure of egg quality — compared to eggs from both free-range organic systems, but they had a higher protein content. Eggs from free-range organic hens had the lowest level of protein in albumen.

Eggs from hens supplemented with omega-3 had the least total saturated fatty acids and the most omega-3 polyunsaturated fatty acids. Eggs from caged hens that weren't supplemented with omega-3 had the most mono-unsaturated fatty acids and the least polyunsaturated fatty acids.

The researchers found no differences in the cholesterol content of eggs from different systems.

Consumers worldwide are increasingly concerned about the quality of commercially available chicken eggs and often believe that eggs from alternative production systems have better nutritional properties, the researchers said.

However, choosing eggs solely on the basis of the production system may not be enough to guarantee superior quality due to factors unknown to consumers, such as age, diet and layer genotype, the investigators concluded.

Researchers evaluate significance of IBV shedding

Shedding of infectious bronchitis virus (IBV) into the environment by infected birds isn't a significant problem if birds are well vaccinated against IBV, but it can be a problem for naïve birds, researchers from the University of Georgia said at the 2015 International Poultry Scientific Forum.[2]

The poultry industry routinely vaccinates broilers with multiple serotypes to try and generate cross-protection against different IBV serotypes. Previous work at the university has shown this approach can protect chickens from clinical signs and lesions associated with IBV infection, but that chickens still shed virus into the environment.

For this study, researchers wanted to determine whether shedding after challenge with a heterologous (dissimilar) IBV is a problem for birds without proper immunity.

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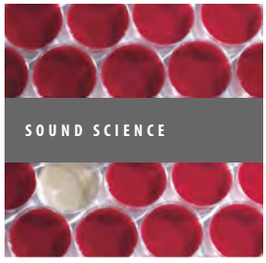


...researchers wanted to determine whether shedding after challenge with a heterologous (dissimilar) IBV is a problem for birds without proper immunity.

Researchers evaluate significance of IBV shedding

They took 40 day-old broilers at industry stocking density in a colony room and vaccinated half of them by eyedrop with IBV Ma5, a Massachusetts IBV serotype, and a Delaware 072 IBV. The rest were left unvaccinated and served as contacts in the room for vaccine transmission. Another group of 20 day-old broilers was housed in isolators and served as unvaccinated controls.

At 35 days of age, investigators challenged the directly vaccinated broilers with pathogenic Arkansas serotype IBV. The unvaccinated controls that had been separately housed were then added to the floor. Every 5 days after challenge, researchers evaluated all broilers for viral load and respiratory signs; they also checked five birds from each group for lesions.

The directly vaccinated birds were protected from challenge at all time points. Unvaccinated and unchallenged contact birds were also protected from signs and lesions at all time points except at 10 days after challenge. The unvaccinated, unchallenged controls were protected at 5 and 20 days after challenge but not at 10 and 15 days after challenge. Viral loads were detected in all birds at different time points after challenge.

Based on this data, the researchers concluded that virus shed into the environment by infected birds isn't significant if the population is well vaccinated, but it can cause signs and lesions in naïve birds.

DDGS linked to necrotic enteritis, higher FCR

Inclusion of dried distillers' grain with solubles (DDGS) was linked to development of necrotic enteritis (NE) and had a negative effect on overall performance, investigators from Auburn University reported at the 2015 International Poultry Scientific Forum.[3]

In their study, researchers assigned 480 male broilers to receive either no DDGS or 15% DDGS in their starter and grower diets. On day 18 of age, they orally challenged birds with *Eimeria maxima* and *E. acervulina* since coccidia predisposes chickens to NE. Then on days 21, 22 and 23 of age, they administered different doses of *Clostridium perfringens*, a pathogen that causes NE. On day 28 of age, the birds were scored for NE and coccidial lesions.

Birds that received 15% DDGS had higher feed-conversion ratios than non-DDGS birds that had received the same challenge dose of *C. perfringens*. They also had significantly higher ($p < 0.05$) NE lesion scores compared to birds receiving lower doses of *C. perfringens*, the researchers said.

The investigators did not note any significant differences among groups due to coccidia, they said.

Low-cost LEDs don't hurt production

Light-emitting diodes (LEDs) may be a good choice of energy-efficient lighting for broilers and their producers, according to recent research.

In a study with more than 670 male Ross broilers, investigators from the University of Delaware evaluated the effects of cold

cathode fluorescent lamps (CCFLs) and two types of LED lamps. Birds raised under incandescent lamps served as controls.

By 42 days of age, birds raised under CCFLs had lower bodyweights than controls. They also had higher heterophil-to-lymphocyte (H:L) ratios — an indication of stress. In contrast, using LEDs did not yield any significant differences in the H:L ratio compared to controls.[4]

"This study indicates that variation in broiler bodyweight and stress may be attributed in part to lighting technologies implemented in broiler houses," researchers reported in the March 2015 issue of *Poultry Science*.

In a separate article in the same issue, the researchers said that birds raised under both LED technologies grew to bodyweights similar to birds raised on incandescent lamps, but there were no significant differences between the groups in feed conversion or mortality.[5]

Similar results were presented at the 2015 International Poultry Scientific Forum, where researchers said LED lighting has no adverse effect on broilers and that it can yield substantial savings for producers.[6]

In their study, the researchers compared electric use in a poultry house with 60-watt incandescent light bulbs to a poultry house with 8-watt, A19-style LED lamps. Chicks in each house had been paired at the hatchery to ensure their parent stock was the same.

Based on results with five flocks, there were no significant differences found in weight, feed conversion or livability between the two houses. Electric savings with the LED lamps were calculated to be US $1,700 per house per year, said researchers from the University of Maryland Extension and the University of Delaware.

Electricity is one of the largest expenses for poultry producers and its cost is increasing. Lighting on broiler farms can represent over 30% of the total cost of electricity when incandescent light bulbs are used, they said. The cost of LED lamps used in the study was $16, and the researchers determined that the payback on lamp cost was 11 months.

"This study demonstrated that LED lamps can be used to lower the electrical usage of poultry farms without affecting production," they said.

High stocking density predisposes broilers to NE

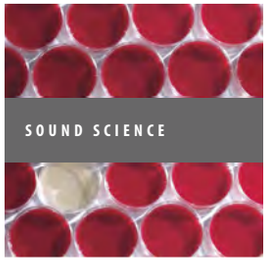
High stocking density has adverse effects on broiler welfare and intestinal health and predisposes the birds to necrotic enteritis (NE), according to the results of an experiment conducted by researchers from the Aristotle University of Thessaloniki.[7]

For their study, investigators randomly assigned 240 day-old broilers to one of four groups. Two groups had normal stocking density, defined as 15 birds/square meter (10.7 square feet), and two more groups had high stocking density, defined as 30 birds/square meter.

Researchers challenged one of the normal and one of the high stocking-density groups with a 10-fold oral dose of an attenuated anticococcidal vaccine plus multiple oral inoculations with a strain of *Clostridium perfringens*. The remaining two groups were not challenged and were used as controls.

The researchers then collected and scored the birds for gross lesions; they also collected intestinal digesta to test for pH and viscosity, and caeca for microbiological analysis.

Investigators found a "significant interaction" between high stocking density and challenge based on their evaluation ($p \leq 0.05$). Compared to unchallenged controls, high stocking density in challenged birds also increased the gross lesion score in the intestines, they reported in the April 2015 issue of *Avian Pathology*.



Hen housing systems compared in 3-year study

Commercial and alternative laying-hen housing systems each have pros and cons, according to a recent study.[8]

Conducted by the Coalition for Sustainable Egg Supply*, the study compared cage-free aviary, enriched colony and conventional cage systems over the course of 3 years and two flock cycles. All three systems were located on a commercial farm in the Midwestern US, and the hens were all Lohmann LSL strain White Leghorns.

There were nearly 200,000 hens in the conventional flock and nearly 50,000 hens each in the cage-free aviary and enriched colony flocks.

Egg production throughout the first half of flock cycles for each system was fairly similar. Production from the aviary system declined the most throughout the remainder of the cycle. Housing type did not affect egg quality at 2 days post-lay nor did it affect the decline in egg quality based on evaluations at 4, 6 and 12 weeks of cold storage.

Hen mortality was "much higher" in the aviary system due to hypocalcemia, egg-yolk peritonitis and excessive pecking. The most egg-yolk peritonitis occurred in the conventional system, however.

Hens in the conventional system also had the highest incidence of foot problems, the fewest keel abnormalities and relatively clean feathers, while those in the aviary system had the lowest incidence of — but most severe — foot problems, the most keel abnormalities and the dirtiest feathers.

Hens in the enriched system had an intermediate incidence of foot problems and keel abnormalities, compared to the other groups, and relatively clean feathers.

To determine physiological stress, investigators used heterophil-to-lymphocyte ratios and white blood cell counts at different points — pullet placement and then again at peak, middle and end of lay. They also weighed the birds' adrenal glands.

"Overall, the physiological data were not suggestive of differences in long-term or short-term stress between the three housing systems," according to the coalition's summary results.

Hens in all housing systems shed *Salmonella* spp. at a similar high rate that was between 89% and 100%. The prevalence of *Salmonella* spp. associated with egg shells, however, was very low and did not differ among systems.

In total, and driven largely by higher feed, labor, pullet and capital costs, the aviary system was 36% more expensive to produce eggs compared to the conventional system, while the enriched colony system was 13% more expensive than the conventional system, primarily due to capital costs per dozen.

The study report warns that the research is a "snapshot in time" and that caution should be exercised when applying the results to other scenarios with different variables.

** The Coalition for Sustainable Egg Supply is a group comprised of animal-welfare scientists, academic institutions, non-government organizations, egg suppliers, and restaurant, foodservice and food retail companies. There are nearly 30 members, including the American Humane Association, Daybreak Foods, Inc., United Egg Producers, Tyson Foods and General Mills. Researchers from Michigan State University, University of California-Davis, Iowa State University and USDA Agricultural Research Service all participated in the research.*

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THE CASE FOR IONOPHORES

Ionophores are unlike other classes of antibiotics and are not considered important to human health by leading public health and regulatory agencies.

Earlier this year, when McDonald's USA announced it would require chicken suppliers to phase out antibiotics, the fast-food giant made one notable exception.[1]

It gave a pass to a class of antibiotics called ionophores — medications like monensin, salinomycin, lasalocid, to name a few — because they're among the shrinking list of in-feed antibiotics not considered medically important to human medicine by the World Health Organization (WHO).

The fast-food chain went on to say it recognizes that judicious use of drugs such as ionophores are an integral part of an overall animal health and welfare program.

For the most part, food-safety advocates, veterinarians and poultry industry groups reacted favorably to McDonald's announcement, calling it a sensible compromise — one that addressed consumers' growing concerns about antibiotics while allowing the continued use of certain medications for maintaining good flock health and welfare.

In this special report, *Poultry Health Today* looks at the science behind ionophores and why they're viewed differently from other antibiotics.

Understanding ionophores

The first thing poultry decision-makers need to know is that ionophores are not used in human medicine.

Although they are classified as antibiotics, they are not even used therapeutically in chickens to treat bacterial infections. They are used as antiparasitics to manage coccidia, a family of protozoan parasites that cause coccidiosis — widely considered the most costly intestinal disease of poultry.

Coccidia are persistent parasites found worldwide on all types of poultry farms, whether they are small backyard hobby flocks or large commercial operations. Just one microscopic coccidial oocyst, or egg, can produce over 500,000 progeny in just 4 to 7 days.

If not kept in check, coccidia cause extensive gut damage, animal suffering and, in severe cases, death that leads to huge economic losses for poultry farmers.

Coccidiosis also predisposes chickens to other problems, such as clostridial bacterial infections, which can lead to another serious gut disease known as necrotic enteritis.

Guilt by association

Poultry veterinarians and producers consider ionophores essential for maintaining the health and welfare of commercial flocks, while working to meet the ever-growing world demand for affordable poultry.

But if ionophores in poultry are used only to control parasites, why are they even considered antibiotics?

Like many other antibiotics, ionophores are derived from naturally occurring bacteria.[2] Monensin, for instance, is derived from *Streptomyces cinnamonensis*; salinomycin is derived from *Streptomyces albus*. They are also active against many Gram-positive bacteria.[3]

> Poultry veterinarians and producers consider ionophores essential for maintaining the health and welfare of commercial flocks, while working to meet the ever-growing world demand for affordable poultry.

That puts ionophores in the antibiotic club, even though they work very differently compared to the antimicrobials that are used in human medicine.

Ionophores can also lose their effectiveness against coccidia when used for prolonged periods — another trait associated with antibiotics. But according to scientists who have closely studied this family of antibiotics, reduced sensitivity to ionophores used in food animals does not jeopardize the effectiveness of antibiotics used in human medicine.

Unfortunately, some of their conclusions about ionophores were misrepresented in some media reports.

Ah-ha moment?

For example, in one of the earlier studies designed to determine whether ionophores pass resistant bugs through the food chain, microbiologists Adam J. Houlihan, PhD, of Cornell University, and the late James B. Russell, PhD, of Cornell and USDA, sought to determine if a bacterium resistant to the ionophores monensin and lasalocid was also resistant to antibiotics used in humans.[4]

The bacterium they used was *Clostridium aminophilum* F, which is found in ruminants such as cattle. They created ionophore-resistant cultures of the organism in the lab, then tested the lab-adapted cultures for sensitivity to several antibiotics used in people, including penicillin G, ampicillin, cephalosporin C, vancomycin, tetracycline and bacitracin.

To judge an antibiotic's sensitivity, scientists usually look at its minimal inhibitory concentration (MIC) — the lowest concentration of antibiotic under which bacterial growth is no longer detectable. The higher an antibiotic's MIC against a specific organism, the less sensitive it is to the test antibiotic in culture.

The Cornell scientists found their ionophore-adapted cultures had the same sensitivity to most classes of antibiotics

tested. The one exception was bacitracin — a drug in a different antibiotic class from ionophores. It had higher MIC values, the researchers wrote in a 2003 published article.

Zealots in search of a smoking gun seized on the finding with bacitracin, which is used in some topical and ophthalmic ointments for people but isn't considered important to human medicine by the US Food and Drug Administration.[5,6]

They said the study demonstrated "that one cannot claim that ionophores cannot select for cross-resistance to any antibiotic used in human medicine," according to an article on consumersunion.org.

Drawing upon the same 2003 study, an article on foodsafetynews.com jumped on the anti-ionophore bandwagon and asserted that all uses of antibiotics had the potential to decrease the effectiveness of antibiotics in people and that ionophores were "no exception."

Missing text

Both claims would have made compelling sound bites, but these reports were misleading. For one, *C. aminophilum* F isn't an organism found in people.

The reports also omitted important comments about the study from the researchers, who said their results suggest that "virtually any *C. aminophilum* F cell has the capacity to become resistant."

continued

COVER STORY

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Canada studies find no links between ionophores, resistance of other antibiotics

One of the few studies about antibiotic resistance and ionophores in poultry was published by Canadian researchers in 2007. They tested 197 *Escherichia coli* isolates from experimental broiler chicks fed different antimicrobials, including the ionophore salinomycin, then determined if the isolates were resistant to other antibiotics.[10]

Resistance to three of 18 antibiotics tested — ceftiofur, spectinomycin and gentamicin — were slightly higher among isolates from chickens fed the ionophore. However, all six treatment groups, including an untreated control group, yielded isolates that showed similar degrees of multiple antibiotic resistance as well as resistance to these three (and other) antibiotics.

More importantly, overall resistance levels markedly decreased from days 7 to 25 of age ($p < 0.001$) across all groups, including the salinomycin treatment group. Decreasing resistance with the use of salinomycin was also demonstrated in early studies conducted with this ionophore.[11,12]

In their conclusion, the Canadian researchers stated that isolates showing resistance to multiple antibiotics can be found in broilers regardless of the antimicrobials used.

LITTER STUDY

In a 2010 published study, researchers tested poultry litter for the presence of veterinary pharmaceuticals — including ionophores such as salinomycin and monensin — and their effect on *Escherichia coli* resistance.

The researchers concluded that "the numbers of generic *E. coli* recovered in litter materials were not significantly influenced by antimicrobial feed supplementation."

In addition, resistance to several antibiotics such as amoxicillin, ceftiofur, gentamicin and sulfonamides was also present in isolates from chickens that had not received antibiotics in their diet.[13]

The researchers' take-away message: "The use of ionophores in cattle feed and the selection of ionophore-resistant ruminal bacteria does not necessarily lead to other types of antibiotic resistance."

Different mode of action

Later in 2003, the same researchers published another article about the resistance of ruminal bacteria to ionophores and its potential impact on human health.[7]

Noting ionophores' distinctly different mode of action from therapeutic antibiotics, they once again concluded there was little evidence that ionophores in animal feed was likely to have a significant impact on the transfer of antibiotic resistance from animals to man.

In yet another 2003 published paper, researchers from USDA and Oregon Health Sciences University reviewed theories about the effect of different ionophores used in ruminants on pathogenic bacterial populations.[8]

Although concerns had been raised about ionophores and their potential for transferring cross-resistance to antibiotics used in humans, "It appears that ionophores do not promote the development or dissemination of antibiotic resistance, likely due to the complex nature and high degree of specificity of ionophore resistance mechanisms," the scientists concluded.

Ionophores acquitted again

In 2008, a study was published about the effects of ionophores on two types of enterococci — *Enterococcus faecalis* and *E. fecium*.[9] These are both Gram-positive bacteria found in the gastrointestinal tracts of people, and in ruminants and other livestock, including poultry. They survive outside the gut in the environment and may cause infection under the right circumstance.

The researchers said they conducted the study, which involved mixed ruminal cultures, because enterococci resistance to vancomycin — an antibiotic used in human medicine — was an increasing threat to people.

But they also acquitted ionophores: "Our results indicate that the role of [commonly used] ionophores in the dissemination of antibiotic-resistance genes through the intestinal *Enterococcus* spp. appears to be limited," they said.

It's important to note that these studies absolving ionophores were done in ruminants, not poultry.

Used 'over 40 years'

"We can't assume that results with ionophores and pathogens affecting poultry would be the same as results with ionophores and ruminant pathogens because the gastrointestinal tract differs among different species," acknowledged microbiologist Charles Hofacre, DVM, PhD, a professor at the University of Georgia involved in research with antibiotic resistance.

On the other hand, he added, "it could be theorized that results might be the same because the studies with ruminant pathogens were conducted *in vitro* — with cultures — versus in animals.

> "We'd have seen a lot more resistance with antibiotics used in people if ionophores caused resistance to other classes of antibiotics."
>
> CHARLES HOFACRE, DVM, PHD

"The poultry industry has been using ionophores for over 40 years," he told *Poultry Health Today*. "We'd have seen a lot more resistance with antibiotics used in people if ionophores caused resistance to other classes of antibiotics."

Reduced sensitivity vs. resistance

In addition, one researcher — a USDA microbiologist who has conducted studies with ionophores and agreed to background *Poultry Health Today* without attribution — noted that when some ruminal bacteria are exposed to ionophores, they may develop "reduced sensitivity," but that isn't the same as true resistance.

"When ionophores are removed, the reduced sensitivity of the bacteria quickly fades away," he said.

"Reduced sensitivity is not a transmissible thing and because ionophores operate by totally different mechanisms [compared to other antibiotics], there has been no indication that reduced ionophore sensitivity has any impact on resistance to other antimicrobials," he explained.

CHARLES HOFACRE, DVM, PHD

Ionophores look different to other scientists, too

Several organizations have drawn the line distinguishing ionophores from other types of antibiotics.

The Natural Resources Defense Council, a non-profit, environmental advocacy group, acknowledged the difference in an issue brief, "Pharming Chickens: It's time for the poultry industry to demonstrate antibiotic stewardship."

The article asserted that the widespread use of antibiotics in poultry production was breeding drug-resistant bacteria that threaten human health, but in an endnote, added: "There has been little indication to date that the use of ionophores [to treat coccidiosis in animals] promotes resistance to antibiotics important to human medicine."

A section on antimicrobial feed additives in *The Merck Veterinary Manual* — the veterinary edition of the prestigious *Merck Manual* long used as a reference by medical doctors — states that "ionophores…do not have any link or possible effect on antimicrobial resistance to therapeutic antibiotics in either people or food animals; to group all antimicrobials together for debate about the risk to therapeutic antibiotics is ill advised and overly simplistic."

Ionophores are not listed by FDA nor WHO as medically important to human medicine.[14,15]

"THERE HAS BEEN LITTLE INDICATION TO DATE THAT THE USE OF IONOPHORES PROMOTES RESISTANCE TO ANTIBIOTICS IMPORTANT TO HUMAN MEDICINE."

Are ionophores antibiotics? That depends on whom you ask

In the EU — a market often perceived to be less tolerant of antibiotic use in food animals than the US — antibiotics used for growth promotion were banned in 2006. However, certain ionophores, such as monensin and salinomycin, are still widely used for managing coccidiosis in poultry. Another ionophore, lasalocid, is also available in Europe for the same purpose.

Richard Raymond, PhD, former undersecretary for agriculture and food safety at USDA, noted this distinction in a recent blog for Meatingplace.com.

"By FDA definition, ionophores are antibiotics. By EU definition, they are anticoccidials," he wrote. "That's a big difference because it means that in the EU 'raised without antibiotics' may mean ionophores were used, preventing the highly contagious coccidiosis, saving chickens from premature deaths and keeping poultry prices lower."

Even criteria behind one government-approved meat label makes an exception for ionophores.

For example, the USDA defines "naturally raised" as meat and meat products raised entirely without growth promotants, without animal byproducts in feed and without antibiotics — *except for ionophores used as anticoccidials*.

COVER STORY

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Are there practical alternatives to ionophores?

Proponents of raising broilers without ionophores and other antibiotics have proposed putting more emphasis on farm management, biosecurity and alternatives to anticoccidials.

But so far, these appear to be insufficient for managing coccidiosis year-round in the large-scale production operations needed to supply the growing global demand for poultry, which is expected to more than double by 2050, according to projections by the Food and Animal Organization of the United Nations.

MANAGEMENT NOT ENOUGH

"Although management and biosecurity measures could halt the introduction of [the parasites that cause coccidiosis] to a farm, in practice they do not suffice to prevent coccidiosis outbreaks," according to a report by Herman Peek, PhD, and Wil Landman, DVM, PhD,[16] both prominent poultry researchers in the Netherlands.

In a 2011 paper, they noted that alternative treatments such as phytotherapy (plant and plant products usually fed as nutritional supplements), aromatherapy and pre- and probiotics "either show conflicting, non-consistent or non-convincing results, and have therefore not been applied at a large scale in the field."

VACCINATION'S POTENTIAL

In time and with improvements, vaccination against coccidiosis could provide an efficient and low-cost anticoccidial strategy, these researchers say, but they acknowledge that currently there are practical challenges with the production and year-round use of coccidiosis vaccines.

"Although management and biosecurity measures could halt the introduction of [the parasites that cause coccidiosis] to a farm, in practice they do not suffice to prevent coccidiosis outbreaks."

In the meantime, many poultry veterinarians need to depend on ionophores — not only to prevent the devastating health and welfare consequences that coccidiosis can have on poultry, but also to ensure the sustainability of the modern poultry operations necessary to feed the world's growing population.

According to Reuters, one major US producer's transition to poultry raised without antibiotics "led to unexpectedly high bird-mortality rates, a need for more chicken houses and spending at least $4 million more a year on vaccines than rivals who haven't made the switch."

THE PRICE OF ELIMINATION

Published reports indicate that poultry operations not using any type of antibiotic, including ionophores, are indeed experiencing setbacks in production and flock welfare.

According to Reuters, one major US producer's transition to poultry raised without antibiotics" led to unexpectedly high bird-mortality rates, a need for more chicken houses and spending at least $4 million more a year on vaccines than rivals who haven't made the switch."

The report added, "Birds raised without antibiotics also generally take 3 to 9 days longer to reach their market weight" — or as much as 20% longer than conventionally raised birds.

COSTLY FOR EVERYONE

That reduced efficiency apparently has trickled down to consumers shopping at their local meat case.

A Reuters report also pointed out that a generic store-brand chicken raised in a conventional production system normally costs around $1.50 per pound. Conversely, an organic chicken — one raised without any type of antibiotic including an ionophore — costs anywhere from $2.69 per pound to as much as $10 per pound at upscale butcher shops.

There's another concern that arises when ionophores used to manage coccidiosis are eliminated from poultry operations. The result could be more sick birds with gut disease that requires therapeutic doses of antibiotics that *are* important to human medicine.

'KEEP THE ANIMALS HEALTHY'

For example, chickens with coccidiosis are more likely to develop necrotic enteritis, the potentially deadly disease that causes gut tissues to die. One of the treatment options for the disease is penicillin, which FDA considers "highly important" to human medicine.

As infectious disease specialist Randall Singer, DVM, PhD, University of Minnesota, put it in an article for bestfoodfacts.org, "The best way to avoid the need for high-dose, clinically important antibiotics is to keep the animals healthy in the first place."

"When we choose not to use ionophores, we're making a decision to let birds die. Let's be frank about it."

Omitting ionophores raises ethical conflicts for veterinarians

Some advocacy groups believe that more restaurants and foodservice companies should follow the lead of Chipotle, Panera and Chick-fil-A. These companies — which only buy chickens raised without any products classified as antibiotics, including ionophores — use this policy as a strategy for marketing to consumers.

Most poultry veterinarians cringe at the notion, however, and think eliminating ionophores on a large scale would jeopardize the sustainability of the industry, as well as the health and welfare of poultry flocks.

As one production veterinarian speaking anonymously at a poultry industry roundtable bluntly put it: "When we choose not to use ionophores, we're making a decision to let birds die. Let's be frank about it."*

*** For a copy of the roundtable proceedings, go to poultryhealthtoday.com/free-proceedings-booklet.**

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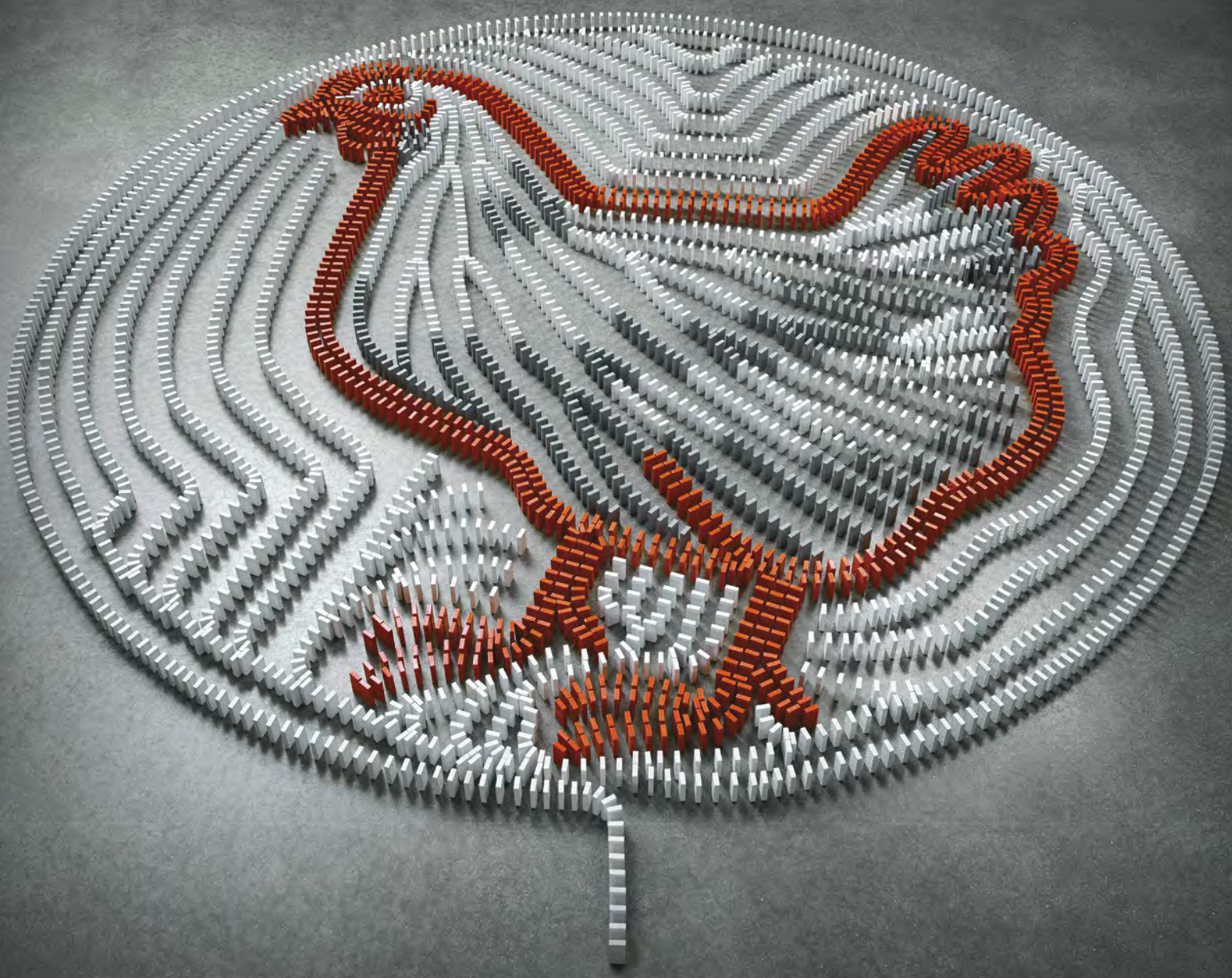

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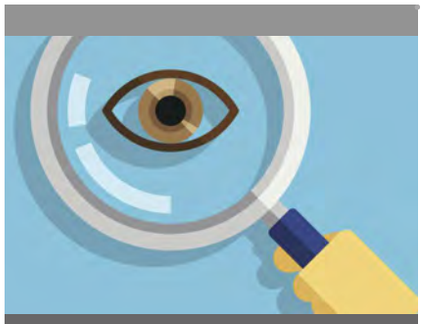


DIAGNOSTICS

PCR REVEALS UNEXPECTED SPECIES OF *EIMERIA* IN US BROILER HOUSES

Polymerase chain reaction analysis, commonly known as PCR, is helping researchers get a better handle on the presence and scope of coccidial pathogens — and the results are surprising, according to a study conducted by the University of Georgia and Southern Poultry Research.[1]

Of 29 samples, the researchers found *E. acervulina* in 96%, *E. maxima* in 93%, *E. tenella* in 89%, *E. brunetti* in 86%, *E. praecox* in 86%, *E. mitis* in 48% and *E. necatrix* in 24%, the researchers reported at the 2015 International Poultry Scientific Forum.

E. acervulina, E. maxima and *E. tenella* had been thought to be the "big three" *Eimeria* species in US broiler houses. However, PCR is demonstrating that other species may be present, researchers A. Lorainne Fuller, PhD, and graduate student Emily Kimminau, told *Poultry Health Today*.

MORE RELIABLE

Before PCR, *Eimeria* species were differentiated based on the location and appearance of coccidial lesions. PCR provides a more reliable diagnostic method and is a relatively easy way to differentiate *Eimeria* species and determine the causes of coccidiosis on a poultry farm, Kimminau said.

The unexpected finding of *Eimeria* species such as *E. necatrix* could be the result of changing approaches to coccidiosis management. Some producers are relying more on coccidiosis vaccination instead of conventional anticoccidials, which may explain the upsurge in *Eimeria* species not present in the vaccines, Fuller, a parasitologist, explained.

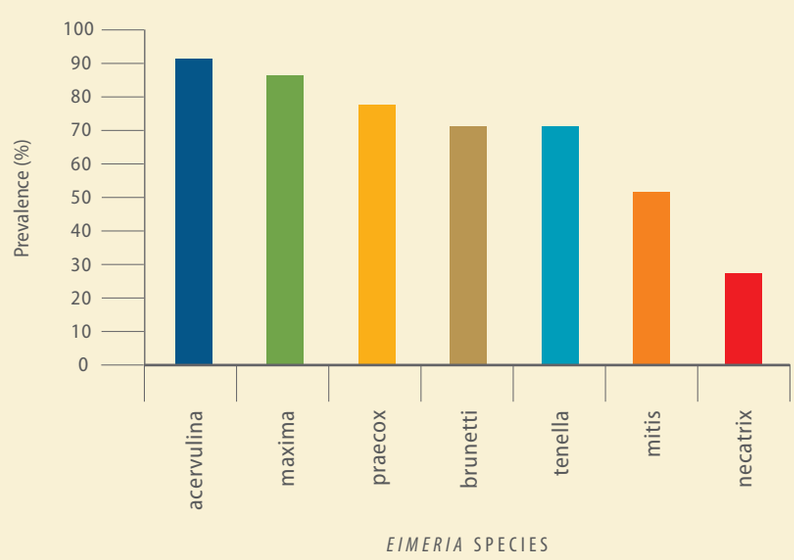
With a 24% prevalence, pathogenic *E. necatrix* warrants further investigation as a potential addition to coccidiosis vaccines, the researchers added.

"I think the best thing about PCR and what has set it apart from what's been done before is that you can get accurate answers. Before a lot of it was guessing."

EMILY KIMMINAU

> "Some producers are relying more on coccidiosis vaccination instead of conventional anticoccidials, which may explain the upsurge in *Eimeria* species not present in the vaccines."
>
> A. LORAINNE FULLER, PHD

Eimeria species identified in US broiler complexes, 2013- 2014



Results from PCR conducted on 43 complexes from across the US. Results shown are the percentage of positive PCR results for the respective species. The PCR detection method was strictly diagnostic of presence/absence; no quantification of the species was measured.

ALLOWS BETTER PLANNING

Eimeria diagnostics in the study was performed as part of anticoccidial-sensitivity testing (AST), which is a very valuable tool, Fuller emphasized.

AST will reveal which anticoccidials are most likely to be effective against the *Eimeria* species responsible for coccidiosis on a farm, which in turn enables producers to plan more effective anticoccidial-rotation programs, she said.

"I think the best thing about PCR and what has set it apart from what's been done before is that you can get accurate answers," Kimminau said. "Before a lot of it was guessing."

Watch a video of the interview at poultryhealthtoday.com/videos.

Editor's note: Emily Kimminau is now a graduate assistant at Texas A&M University.

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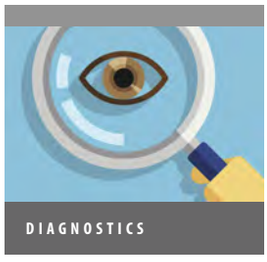


GROSS COCCIDIAL LESION SCORES APPEAR TO PREDICT MICROSCORES

Gross coccidial lesion scores appear to be predictors of microscores, Miguel Barrios, a graduate student at the University of Georgia, said at the 2015 International Poultry Scientific Forum.[1]

Microscopic oocyst counts of intestinal scrapings, also called microscores, are often investigated along with bodyweight gain and gross intestinal lesion scores as part of anticoccidial sensitivity tests (AST), which are conducted to determine the efficacy of anticoccidials against *Eimeria* field isolates, Barrios said.

CHALLENGE STUDY

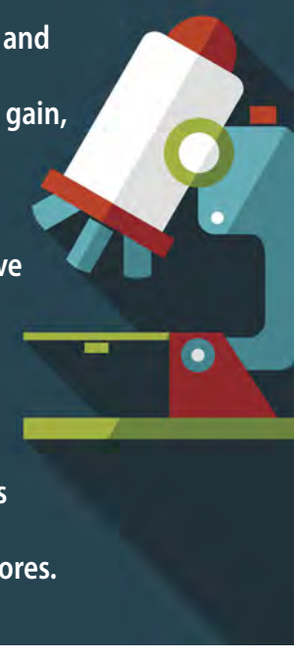
In a study, Barrios and colleagues from the university, with support from Zoetis Inc., determined the correlation between broiler bodyweight, gross lesion score and microscores as part of three ASTs.

There were 288 chicks per AST. On day 13 of age, investigators gave each group one of 10 anticoccidials including lasalocid, salinomycin, monensin and narasin. For controls, they had one group that was not medicated or infected and another group that was not medicated but infected.

On day 15, the researchers challenged chicks in the medicated groups and the unmedicated control group with *Eimeria* oocysts from the field. One day 21, they weighed the birds and classified gross lesion scores and microscores from *Eimeria maxima* using the 0 to 4 Johnson and Reid evaluation method.

Investigators found no correlation between microscores and bodyweight gain, but there was a positive correlation between gross lesions and microscores ($p = 0.004$). There was also an interaction between microscore and isolate, which may be due to the differing pathogenicity of the challenge isolates. This finding indicates that the significance of the correlation between microscores and gross lesions may depend on the *Eimeria* strain, Barrios said.

Investigators found no correlation between microscores and bodyweight gain, but there was a positive correlation between gross lesions and microscores.



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Pathways to protection

How one vaccine decision can affect options for managing other diseases in BROILERS

POULTRY HEALTH TODAY

Broiler operations naturally want to provide the best disease protection for the least cost, but deciding which vaccines to use and when can be a daunting task.

First, there are so many variables to consider — not just disease pressure and the emergence of new variants, but also geographic location, proximity to other farms, temperature, litter moisture, housing type, ventilation, lighting, bird density, target weight and labor.

Then there's the overwhelming arsenal of vaccines. Producers have a deep war chest of modified-live, inactivated, autogenous and recombinant vaccines that can be administered in a variety of ways, at different times — often in combination with other immunizations.

Every flock and farm is different and there's no such thing as a blanket program. So how should broiler farms go about planning cost-effective vaccination programs? And how does one vaccine decision affect a poultry company's options for managing other diseases?

Poultry Health Today asked two experts with extensive experience evaluating vaccination programs on hundreds of farms — Kalen Cookson, DVM, MAM, and Lloyd Keck, DVM, ACPV — for help in navigating the path to sensible, strategic and cost-effective disease protection.

Square one

What to use for Marek's disease is usually the first step toward planning a broiler-vaccination program. Even though the incidence of tumors is generally low in US broilers, the Marek's disease virus is ubiquitous and always a potential cause of immune suppression. "That's why all broiler operations continue to immunize their flocks against this highly contagious disease," Cookson says.

While traditional live vaccines for Marek's are available, many US broiler operations obtain Marek's protection from a herpesvirus of turkey (HVT) recombinant vector vaccine administered *in ovo*. HVT helps protect against Marek's and serves as a vector to help provide protection against one of three other costly diseases — infectious bursal disease (IBD), infectious laryngotracheitis (ILT) or Newcastle disease (ND).

Though more expensive than traditional vaccines, the recombinant vector vaccines are popular with broiler producers because they're easy to administer and offer a high margin of safety, with virtually no reactions that can impede flock performance.

The only hitch: Not more than one HVT vaccine, whether a recombinant or not, can be used at the same time because they will compete with each other and become less effective.

That means producers fire only one HVT bullet, so to speak. If they use an HVT-based recombinant to help protect flocks against IBD, that rules out using one for ILT and ND. Likewise, if flocks receive an HVT-based vaccine for ND or ILT, producers will need to resort to other types of vaccines for the other two diseases.

Choosing your weapon

So, if broiler farms get only one shot with an HVT-based recombinant, which disease should they target?

It really comes down to disease pressure, time of year and other vaccination options. Keck recommends using lab testing and physical evidence of disease damage as a starting point. "You want to find the recombinant that'll deliver the most value in each particular situation," he says. "Then use traditional vaccines to manage the other major diseases."

Here's an overview of four different vaccine scenarios for broilers, with and without recombinants:

continued

Photo: Kalen Cookson, DVM, MAM, and Lloyd Keck, DVM, ACPV
Photo by Joseph Feeks

Soup's up!

It's hard to talk about vaccines without serving a bowl of alphabet soup. Here is a key to vaccine and disease abbreviations used in this article, presented in alphabetical order.

C2	Non-reactive, cloned strain of B1 NDV
CEO	Chicken-embryo origin
FPV	Fowlpox virus (used to make some recombinants)
GA 08	Georgia 2008 variant of IBV
HVT	Herpesvirus of turkey (used to make major recombinant vaccines for IBD, ILT and ND)
IBD	Infectious bursal disease
IB	Infectious bronchitis
IBV	Infectious bronchitis virus
ILT	Infectious laryngotracheitis
ND	Newcastle disease
NDV	Newcastle disease virus

PROGRAM A

USING A RECOMBINANT FOR

IBD

> "IBD control begins with the broiler-breeder that shares passive immunity with the broiler. You want the vaccine to match the field challenge as closely as possible." KALEN COOKSON, DVM, MAM

When to consider it

Recombinant IBD vaccines are usually the first choice when ILT, ND and infectious bronchitis virus (IBV) pressure is low and growers are faced with a high — or early — IBD challenge.

Winter and spring are peak challenge times for IBD due to lower temperatures and reduced ventilation, which increases the concentration of the virus and field challenge over time.

The recombinant IBD vaccine has been demonstrated to be highly effective on many farms. However, growers must remember that continuous use of a recombinant IBD vaccine only buffers the challenge from the field virus. The viral load and production losses will usually decrease, but the virus continues to replicate, Cookson says. "That allows reinfection in the next cycle of birds and the possible selection of more 'fit' subpopulations over time," he adds.

Managing maternal antibodies plays a key role in any effective IBD-control program. "IBD control begins with the broiler-breeder that shares passive immunity with the broiler," Cookson says. "You want the vaccine to match the field challenge as closely as possible."

Options for managing ILT

If an HVT-based recombinant vaccine is being used for IBD, there are two options for managing ILT. One is a fowlpox virus (FPV)-based recombinant for ILT, which can be used without fear of replication competition.

However, the gold standard for ILT control, particularly in large birds, is the modified-live, chicken-embryo origin (CEO) vaccine.

A CEO vaccine can produce a "sterilizing immunity" against the ILT virus and helps break the challenge cycle, Cookson explains. At the same time, however, the CEO vaccine has the potential to spread the disease to unvaccinated birds. Strict biosecurity helps reduce the spread of ILT between vaccinated and unvaccinated barns.

Farms planning to begin a CEO vaccination program should increase biosecurity measures, share plans with neighboring farms and encourage collaboration on vaccination programs.

Options for managing ND

Without a recombinant ND vaccine in the mix, producers must select more traditional ND vaccines, based on disease pressure and history. Available vaccines vary from the nonreactive C2 through the less-attenuated B1 strains.

During winter months, many operations choose to use a C2 vaccine — one that limits reactivity and helps growers avoid putting additional stress on the birds, Cookson says. However, using C2 year-round allows field-virus levels to build — eventually making C2 less effective, particularly against a late NDV challenge.

Cookson recommends "moving up the reactivity/efficacy scale" during summer with a vaccine such as Poulvac® Aero ND. "That approach will help to decrease circulating virus levels and help prevent late-season challenge," he explains.

PROGRAM B

USING A RECOMBINANT FOR

ILT

> "If a grower is seeing very high mortality rates, the cost of two vaccinations may save money in the long run." LLOYD KECK, DVM, ACPV

When to consider it

Once viewed as a cold-season virus, ILT has become a year-round threat in many broiler-production strongholds of the US. Cold, wet weather and reduced ventilation often trigger ILT outbreaks.

Producers frequently choose to use a recombinant ILT vaccine in situations of low challenge or if the challenge is not present but there is a risk of exposure, particularly in medium-sized birds.

A recombinant vaccine can also be used to jump-start ILT protection and serve as a reaction buffer when a modified-live field vaccine is needed at 14 days.

Keck says that in cases of very high risk or outbreak situations, a recombinant ILT vaccine administered *in ovo,* followed by a CEO vaccine in the field, may be needed to help reduce mortality levels and ensure ILT immunity. "If a grower is seeing very high mortality rates, the cost of two vaccinations may save money in the long run," he explains.

When transitioning off a modified-live vaccine program, producers can opt to use a recombinant vaccine *in ovo* to help buffer against what has hopefully become a diminishing field challenge. It can also be insurance against any residual vaccine persistence.

According to Keck, birds raised to less than 4 pounds (or 5 weeks of age) seldom exhibit mortality from ILT. So, unless growers are facing an outbreak, it may not pay to vaccinate small birds. If an ILT recombinant is needed in a small bird, the FPV recombinant vaccine can be used since it causes fewer reactions and costs less than the HVT vector vaccines.

Bottom line: Each farm needs to look at its history, the surrounding production area and the age and weight of birds when selecting its primary and secondary options for ILT vaccination.

Options for managing IBD

Using a recombinant ILT vaccine presents more options for managing IBD. Among conventional modified-live vaccines, Cookson recommends either using a mild IBD vaccine with Marek's or an intermediate vaccine that can be administered at 8 to 10 days or with a ND/IBV field boost at 14 to 18 days.

Administering an immune-complex vaccine such as Bursaplex® along with a Marek's vaccine *in ovo* is another option. This type of vaccine helps provide strong IBD protection as maternal antibodies decline, he says, thus delaying and reducing the period of infection while allowing for quicker recovery of the bursa of Fabricius — a specialized organ necessary for B cell development in birds.

Another way to help reduce IBD virus levels is to continue vaccinating throughout the summer. Summertime vaccination combined with better ventilation rates reduces IBD pressure going into the following winter.

Options for managing ND

(See ND recommendations under Program A.)

continued

PROGRAM C

USING A RECOMBINANT FOR

ND

A recombinant, HVT-based ND vaccine helps offer growers "peace of mind" protection.

When to consider it

ND peaks in the winter and spring months when cold, wet weather and reduced ventilation rates help the virus replicate. A recombinant, HVT-based ND vaccine helps offer growers "peace of mind" protection, Cookson says, while allowing them to focus live respiratory vaccination on IBV, which also spikes in winter. (See IBV recommendations in the next section.)

While the recombinant ND vaccine is more expensive, it offers little reactivity with moderate disease control. Fortunately, circulating ND viruses in the US are not extremely pathogenic and tend to infect at later ages, allowing recombinant ND vaccines the opportunity to be effective in most situations. Again, the ND vaccine decision must be based on flock history and challenge levels.

Options for managing IBD

(See IBD recommendations under Program B.)

Options for managing ILT

(See ILT recommendations under Program A.)

Complex decisions require expert advice

Developing a vaccination program targeting optimal performance and return requires more planning and expertise than local "experts" at the farm store can offer. Relying on professional advice helps producers avoid the shotgun approach — shooting at everything with the hope it

PROGRAM D

USING NO RECOMBINANTS

> It really comes down to perceived need versus cost of the recombinant. KALEN COOKSON, DVM, MAM

When to consider it

Recombinant vaccines are a fairly recent addition to the poultry-vaccine arsenal. Cookson estimates that over half of all broiler operations still do not include recombinants in their vaccination programs today.

"It really comes down to perceived need versus cost of the recombinant," he explains.

Many producers still grow chickens without recombinants, based on their flock history, good disease coverage with their current vaccination plan and to avoid the higher cost associated with recombinants.

Options for managing Marek's disease

Of course, Marek's disease can be safely and effectively controlled by using non-recombinant vaccines. The key is to adjust the Marek's program to help provide adequate protection against tumors and performance losses. For many broiler operations, this has meant developing different vaccination programs for summer and winter.

Options for managing IBD, ILT and ND

(See recommendations for each in Programs A and B.)

hits something — which often results in increased costs and reduced disease coverage.

Producers and veterinarians must rely on thorough testing to pinpoint effective vaccine choices and timing. A combination of diagnostics ranging from visual inspection to PCR and histopathology are needed to correctly identify the diseases and variants present in their flocks.

For instance, the chicken-embryo origin (CEO) vaccine is vital in controlling outbreaks of infectious laryngotracheitis in medium and large birds but can result in lost production and income potential when used in small birds due to fever and inappetence associated with vaccination.

The vaccination spectrum ranges from *in ovo* vaccines to day-of-age vaccines at the hatchery to field vaccines. The field vaccines, in particular, can be stressful for birds and increase labor costs. The monetary cost of the vaccine along with often subtle production costs associated with vaccination are just two of the many factors in the decision process associated with an effective vaccination program.

POULTRY HEALTH TODAY

Shift and drift affect vaccination decisions

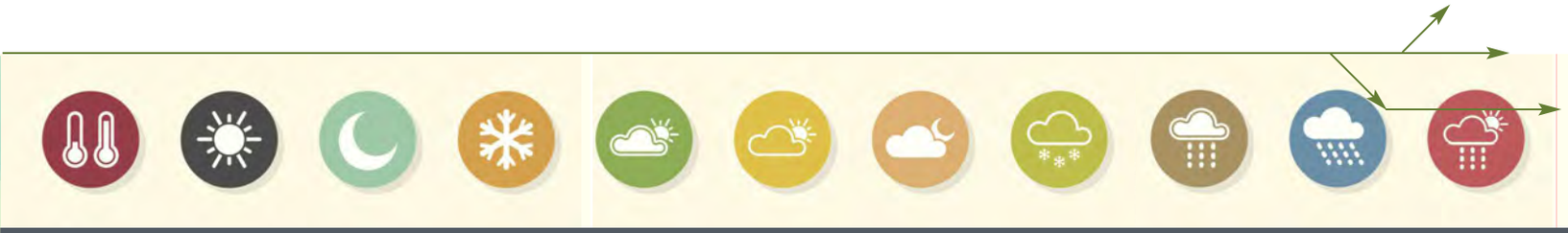
IB viruses constantly replicate, resulting in shifts to their genetic code.

Few viruses in poultry remain static over long periods of time. Slight genetic shifts or mutations that occur during replication result in a genetic code drift away from the original virus. Over time, new variants of the original virus form.

Such is the case with IB Georgia 2008 (GA 08), the novel infectious bronchitis (IB) variant that resulted in devastating losses to the US poultry industry. IB viruses constantly replicate, resulting in shifts to their genetic code. While most of these shifts are incremental and covered by existing vaccines, the GA 08 virus was unique enough that it produced severe disease signs when it reached poultry flocks in the southeastern US. This major shift in genetic code required an entirely new homologous vaccine, one with the same serotype as the virus.

Addressing such shift and drift remains a critical component of disease control and vaccine selection. Veterinarians and producers rely on PCR testing to break down the field-virus components and address novel variants.

In the southeastern US, several IB field viruses circulate annually, and matching serotypes to the field virus offers the best chance for protection. Cookson recommends incorporating no more than three serotypes from the current choices of Massachusetts, Connecticut, Arkansas, Georgia 98, Delaware O72 and GA 08 to help cross-protect without overwhelming the bird's immune system. In high-variant challenge areas, Connecticut is usually the first serotype to be dropped from a program due to its relatively high similarity to Massachusetts.



More diseases, more decisions

There's more to poultry health than Marek's, IBD, ILT and ND. Vaccines also play major roles in curbing these common diseases:

INFECTIOUS BRONCHITIS VIRUS

Cold, wet weather sets the stage for IB outbreaks in broiler flocks. The key to successful control is correctly identifying the circulating virus or viruses. Because the IB virus is constantly mutating, finding the best control measure is like hitting a moving target.

One of the most damaging IB variants is Georgia 08 (GA 08), first identified in the winter of 2007-08. Today, a homologous vaccine helps offer protection from GA 08, but this isn't the only IB strain causing problems for producers.

In many cases, a heterologous vaccine program utilizing vaccines with different serotypes offers cross-protection in the field. Keck recommends obtaining PCR analysis to determine the most prevalent IB serotypes in a flock.

The Massachusetts IB vaccine is an original field isolate that can help provide a baseline of protection. After testing for active serotypes in a flock, broiler companies can use it with one or more of Arkansas, Connecticut, GA 98 or GA 08 vaccines to help extend protection.

Cookson says, when facing a high field challenge, growers need the best antigenic match possible. This may mean using one, two or a maximum of three serotypes to get the best coverage without overwhelming the bird's immune system. The level of protection achieved against IB depends on farm density, the season, the degree of immune suppression and a farm's ability to field-boost.

E. COLI

E. coli has become more prevalent in broiler operations that have discontinued antibiotics in the hatchery. In addition, cool, wet weather increases the incidence of secondary *E. coli* infections due to respiratory challenges from IBV, ILT and ND. *E. coli* can also occur as a primary disease.

As a day-of-age spray, *E. coli* vaccination is gaining acceptance for its ability to help decrease mortality, particularly in large birds, Keck says.

COCCIDIOSIS

Coccidiosis vaccines are often used in poultry raised without antibiotics, as well as in conventional production systems that need to rest in-feed anticoccidials and restore their efficacy. The vaccines tend to be used in summer months, when coccidiosis pressure subsides with increased ventilation. Producers then switch back to ionophores or synthetic anticoccidials.

In the US, broiler operations have the option of administering coccidiosis vaccine *in ovo* or on day 1 as a hatchery spray. According to Cookson, the choice hinges on company philosophy, production history and management preferences.

"The challenge with coccidiosis vaccine is getting good, uniform delivery of the vaccinal oocysts that stimulate the bird's natural immune system," Keck says. "Zoetis research with alternative delivery systems has shown great potential for helping improve vaccine and flock performance."

He points out that the first round of coccidial vaccination is a transition period for most growers as birds often face both a field and vaccination challenge.

"Because vaccines may initially cause short-term intestinal disruption and loss in performance, they are usually more practical and cost-effective to use in medium to large birds that have more time to make up for lost weight," he says.

For more information on developing a long-term vaccination strategy, readers should contact kalen.cookson@zoetis.com or lloyd.keck@zoetis.com.

DISCOVERIES

IBV study compares vaccine protocols for Cal-99 variant

The greatest reduction in viral loads was seen with Massachusetts + Arkansas followed by a booster, suggesting that boosting programs may provide better protection in the face of a high field challenge with Cal-99.

Vaccination with Massachusetts and Arkansas infectious bronchitis virus (IBV) serotypes followed by a booster provided the best protection against a contemporary California 99 (Cal-99) IBV variant in a recent challenge study, Kalen Cookson, DVM, MAM, a technical services veterinarian with Zoetis Inc., said at the 2015 Western Poultry Disease Conference held in Sacramento.[1]

Cal-99 continues to circulate, triggering respiratory disease in California broilers. Previous studies have shown that this IBV variant is most similar to the Arkansas-DPI serotype, and that vaccination with the Massachusetts plus Arkansas IBV serotypes provided more complete protection than Massachusetts plus Connecticut IBV serotypes, he said.

In the current study, researchers from Zoetis Inc. and the University of Georgia compared the protection provided by different vaccine combinations, with and without a booster, against a contemporary Cal-99. They equally divided 120 commercial, newly hatched broilers into eight different treatment groups (Table 1).

On day 31 of age, all birds except those in Group 1 were challenged with Cal-99, which was administered via eye drop, Cookson explained.

The researchers evaluated the results 5 days after challenge based on clinical signs, airsacculitis, histopathology and with real-time polymerase chain reaction (PCR) analysis, which was used to estimate viral loads using threshold cycle values, he said.

Highest viral loads

Challenged control birds had the highest incidence of moderate to severe clinical signs and airsacculitis, their tracheal histopathology was above baseline and they had the highest viral loads, indicating the Cal-99 "take" was successful, Cookson said.

continued

Table 1. Vaccine protocols

Group	Day of hatch vaccination	17-day vaccination
1	No	No
2	No	No
3	Mass + Conn	No
4	Mass + Ark	No
5	Mass + Ark	Mass + Ark
6	Mass + Ark	Holland + Ark
7	Mass + Ark + GA 98	No
8	Holland + Ark	No

I-99

Real-time PCR analysis demonstrated the Massachusetts + Connecticut vaccine protocol reduced viral loads the least; the Massachusetts + Arkansas lowered viral loads more, and similar reductions were seen with Massachusetts + Arkansas + Georgia 98 and Holland + Arkansas.

"These results demonstrate the value of adding Arkansas instead of Connecticut to Massachusetts to reduce Cal-99 infection. However, adding a third serotype, Georgia 98, did not enhance protection nor did substituting Holland for the milder Massachusetts serotype vaccine," Cookson said.

The greatest reduction in viral loads was seen with Massachusetts + Arkansas followed by a booster, suggesting that boosting programs may provide better protection in the face of a high field challenge with Cal-99, he concluded.

[1] Cookson K, et al. Comparison of vaccination programs against a contemporary Cal-99 IBV isolate in commercial broilers. Proceedings of the Sixty-Fourth Western Poultry Disease Conference. 2015.

In broilers, *in ovo* vaccination has become commonplace in many countries, but its value in breeders and layers, where only females are used, has been questioned.

In ovo Marek's vaccine yields benefits for breeders, layers

In ovo vaccination for Marek's disease benefits protection and performance in breeders and layers, according to study results presented at the 2015 International Poultry Scientific Forum.[1]

In broilers, *in ovo* vaccination has become commonplace in many countries, but its value in breeders and layers, where only females are used, has been questioned. Consequently, a study was designed to compare *in ovo* with conventional subcutaneous vaccination protocols for Marek's disease virus (MDV) in female chickens.

With the support of Zoetis Inc., researchers from North Carolina State University divided 1,100 embryos from a single flock into six treatment groups (Table 1).

Dual-needle system

The vaccines used in the study were rHVT-IBD, a recombinant herpesvirus of turkey (HVT) vaccine for Marek's and infectious bursal disease, an SB-1 strain vaccine and CVI-988, a Rispens-strain Marek's vaccine. *In ovo* vaccination was accomplished with the Embrex® Inovoject® dual-needle system, said Taylor Barbosa, DVM, MS, PhD, ACPV, director of outcomes research for Zoetis.

Researchers placed females in isolator rooms with 2-week-old specific-pathogen-free shedder birds that had been previously challenged with the very virulent MDV 648A strain. This method replicates the natural infection route seen in the field, where the virus is shed into the environment by infected birds and is then inhaled by other uninfected birds.

CVI-988 birds gain more

Groups 1, 2 and 6 were commingled into two rooms and kept apart from the other groups. Groups 3, 4, 5 and 6 were commingled in separate rooms. The unchallenged control birds were kept in yet another room with no infected birds.

The researchers obtained feather-pulp samples at 7 and 21 days of age and then weighed all birds at 7, 21 and 49 days of age. They also scored birds at 49 days of

DISCOVERIES

In ovo Marek's vaccine yields benefits for breeders, layers

The results with bodyweight gain and protection demonstrate the benefits of using an efficacious, low-passage CVI-988 vaccine.

age for MDV lesions and protection (Table 1).

They found bodyweight gain on day 21 of age was significantly higher for birds that received CVI-988 compared to both the recombinant vaccine and unvaccinated groups ($p > 0.05$). On the other hand, there were no differences in bodyweight gain between the unvaccinated birds and the two groups that received only the recombinant vaccine, Barbosa said.

At 49 days of age, Group 3 — which received both vaccines *in ovo* — had the highest bodyweight. Unvaccinated controls had the lowest bodyweight, which was no different from the group that received only the recombinant vaccine at hatch. Bodyweight in the remaining Groups 1, 4 and 5 was in the intermediate range.

Table 1. Vaccine protocols in the study

Vaccine groups	*In ovo* to 18-day embryos	Subcutaneous injection at hatch	Protection index at day 49 of age*
1: rHVT-IBD+SB1	●		78%
2: rHVT-IBD+SB1		●	34%
3: CVI-988 + rHVT-IBD+SB1	●		92%
4: CVI-988 + rHVT-IBD+SB1		●	89%
5: rHVT-IBD+SB1 CVI-988	●	●	82%
6: Unvaccinated controls			NA

* Protection index = % Marek's disease (MD) in unvaccinated - % MD in vaccinated/% MD vaccinated x 100

Vaccine benefits

All unvaccinated, challenged birds developed MDV lesions, demonstrating that the challenge from shedder birds was successful. The protection index was highest (92%) for Group 3 — the birds that received both vaccines *in ovo* — followed by Group 4 (89%), then Group 5 (82%) and Group 1 (78%). The protection index in Group 2 that received only the recombinant vaccine at hatch was 34%.

The results with bodyweight gain and protection demonstrate the benefits of using an efficacious, low-passage CVI-988 vaccine, Barbosa said.

"The time between vaccination and MDV exposure has been described as important for protection. Our findings confirm that *in ovo* vaccination of female breeders improves the protection given by all vaccines tested and demonstrates the benefits of *in ovo* vaccination for all birds susceptible to early exposure with field MDV strains," he said.

[1] Barbosa T, et al. Optimizing Marek's diseases vaccination protocols with in ovo vaccination. 2015 International Poultry Scientific Forum Abstracts.

EXPERT ADVICE

Breaches in biosecurity: Lessons learned

PHILIP A. STAYER, DVM | *Corporate Veterinarian, Sanderson Farms, Inc.*

Biosecurity needs to take its rightful place as a top priority for poultry producers in light of the highly pathogenic avian influenza (HPAI) that's currently affecting U.S. commercial poultry flocks.

We can define biosecurity as the procedures put in place to reduce the risk of disease in a population of animals. The best risk is no risk. But as we all know, just about every activity we perform on a poultry farm involves some risk, so the goal is to intelligently limit risks as best we can. This requires imagination to provide useful yet manageable practices that establish barriers between healthy flocks and possible disease reservoirs.

The HPAI situation provides a good example. We know that wild waterfowl carry HPAI, so to keep this disease off poultry farms, we have to limit contact with wild waterfowl and their droppings. Toward this end, we should prohibit farm personnel from hunting and handling waterfowl. We can help keep wild birds away by cleaning up spilled feed, keeping the grass mowed and eliminating standing water near poultry houses. We can require personnel to disinfect the bottoms of their shoes before entering a poultry house and that equipment rolled into a poultry house also be disinfected.

All commercial poultry companies, including Sanderson Farms, Inc., have some type of biosecurity program, often borrowed from a common source such as the National Chicken Council or primary breeder suppliers. At Sanderson, we have historically incorporated biosecurity procedures into our contract producer agreements and other corporate documents.

Unprotected knees cause outbreak

A case in point involved sporadic infectious laryngotracheitis (ILT) outbreaks in our flocks that ultimately resulted in the depopulation of over 700,000 birds. As we all know, ILT is a devastating disease. It starts with upper-respiratory-tract damage and often leads to the death of the infected chickens. The disease has to be reported in every poultry-producing state, so it carries more weight than routine issues with other ubiquitous respiratory diseases. After each ILT clinical case at Sanderson, our veterinary staff conducted on-site investigations to determine the source of the virus and to adjust biosecurity procedures. We didn't want to live up to the old adage that "idiocy is to expect a different result from similar behavior."

Before 2009, our broiler personnel were simply required to wear protective overshoes without any other biosecurity measures. In contrast, biosecurity requirements were more stringent for personnel working with breeding stock, our most valuable asset. Breeder service technicians have always been covered from head to toe with overclothes to assure they didn't introduce disease agents.

In the spring of 2009, however, ILT affected our western-most broiler flocks in east Texas. Upon investigation, our veterinary staff determined the disease was introduced by a basic violation of

We didn't want to live up to the old adage that "idiocy is to expect a different result from similar behavior."

Photo by Joseph Feeks

POULTRY HEALTH TODAY

EXPERT ADVICE

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the existent biosecurity program. The index case was attributed to a contract chicken grower who had processed non-company poultry at his chicken farm. ILT was traced to a Canton, Texas, trade-day, where ILT-vaccinated broilers from Arkansas were sold. The trail of ILT-infected backyard flocks followed major highways west until the last known positive flock was found north of Waco. Apparently, one of these ILT-infected flocks was processed by our grower. The farmer with the index case frequently visited family and friends who were also Sanderson contract growers and, in the process, spread ILT to several other nearby broiler farms.

Soon after the index case, another cluster of farms about 1.5 miles away broke with ILT. The only link between the two ILT areas was a Sanderson service technician. After questioning the technician and examining the affected farms, we figured out that he had carried the virus from one place to another on his unprotected knees. The index farm and all the houses in the secondary cluster had back-up thermostats inside the houses at birds' head height. The service person had to kneel to inspect and check back-up thermostats.

This ILT disaster taught us that all broiler service personnel need to wear clean protective coveralls and head nets, just like their counterparts who care for breeder stock.

The predominant lesson is that biosecurity procedures need to evolve to keep up with disease threats.

Litter hauling linked to ILT

In late January 2011, there was an ILT outbreak in southeastern Mississippi that affected Sanderson as well as other integrator farms. Our index case was on an older farm with a new owner. The previous owner was also a contract litter hauler and moved poultry litter from farms to fields. Although he'd sold the farm, he maintained ownership of the old litter stockpiled in a shed at the end of the property. To pick up the litter, the previous owner had to drive between houses 3 and 4.

The previous owner started hauling the old litter at the same time the new owner was battling gangrenous dermatitis (GD) in house 3 and was in the house frequently to pick up dead birds. Ten days after the GD outbreak started, birds in the house broke with ILT. In this case, we figured out the new owner was picking up the virus from the path the litter hauler used, then carried it into the house to a flock already weakened by GD.

Earlier that winter, ILT had been spreading in north Alabama; the previous owner denied moving litter from Alabama into Mississippi, but the genotype of the Mississippi ILT virus was identical to the one in Alabama. Due to this case, Sanderson now prohibits off-farm litter-handling equipment on any of our farms if flocks are present.

Problem neighbors

Just last year, in spring 2014, we experienced an ILT outbreak in North Carolina, east of where ILT traditionally occurs. Three of our broiler farms were affected. The initial case was due to an

obvious breach of existing biosecurity. As a favor on the way home from work, an equipment serviceman stopped by house 2 on the first affected farm to examine reports of faulty roll-seal doors. The serviceman didn't have any protective equipment in his vehicle, nor did the grower have any spare gear to provide. Exactly 10 days after the repairman's visit, birds near the roll-seal door in house 2 broke with ILT.

The cause of ILT on the other two affected farms wasn't as readily apparent. Both farms have long farm lanes and aren't close to other poultry farms. The only link to the first case was the serviceman, but his travel pattern didn't match up with the ILT breaks on the other two farms.

Further investigation revealed the source was likely vehicle tires. A neighbor integrator in the area had flocks with ILT, and vehicles from Sanderson contract farms used the same route the neighbor integrator used to transport dead birds.

Realizing that we can't change a neighbor's behavior, our veterinary staff instead increased our own biosecurity. We now routinely require that tires and the undercarriage of service vehicles be disinfected before entering one of our farms and that service technicians disinfect their shoe soles before they get into their vehicles. We require the same for growers and their vehicles if there's a disease threat situation.

Realizing that we can't change a neighbor's behavior, our veterinary staff instead increased our own biosecurity.

Steps to take when outbreak strikes

These three cases demonstrate how biosecurity needs to evolve. There are six steps that can help poultry producers with the "production epidemiology" that's needed when a disease outbreak occurs:

- **Have someone knowledgeable visit each affected farm and talk to all folks working there about the chain of events.**
- **Attempt to construct a reasonable story about how the pathogen gained entrance onto the farm.**
- **Identify breaches or deficiencies in current biosecurity practices.**
- **Plug the holes in biosecurity that are identified.**
- **Have managers and veterinarians inspect what's needed to ensure the proper biosecurity procedures are in place.**
- **Finally, share the lessons learned with others so they can avoid making the same biosecurity mistakes.**

Hopefully, the experiences at Sanderson that I've shared in this article will help other poultry producers improve their biosecurity procedures and prevent devastation from ILT and other serious diseases such as HPAI.

POULTRY HEALTH TODAY

POSTINGS

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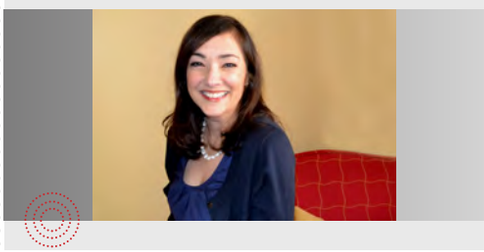
ILT control options present double-edged sword

For broilers in endemic areas exposed to high levels of the ILT virus early in life, it may be time to rethink how ILT vaccination is approached, writes University of Georgia's Maricarmen Garcia, MS, PhD.



Confused about VFDs? Specialists bring clarity to new antimicrobial rules

A recent webinar shed light on Veterinary Feed Directives and what they mean to poultry and livestock production.

Backyard flocks biggest risk for spreading vvIBDV in US

"The unrestricted movement of backyard poultry is probably the biggest risk factor for the spread of vvIBDV to even more bird-dense regions in the US," says Daral J. Jackwood, PhD, The Ohio State University.

Update on Georgia 08 infectious bronchitis variant

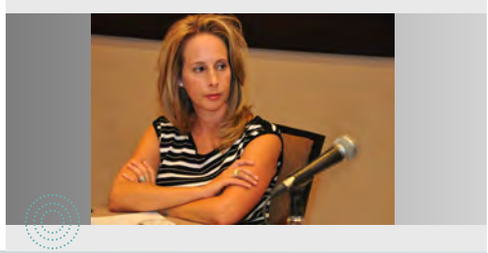
While condemnation at the processing plant is the main consequence of Georgia 08 variant of infectious bronchitis, secondary infections such as *Escherichia coli* may cause mortality, reports Tim Cummings, DVM, DACPV, of Zoetis Inc.

Sizing up McDonald's order

US poultry health specialists react to fast-food giant's antibiotic policy and its possible outcome on flock health and welfare.

Forbidding antibiotics in poultry threatens animal welfare, veterinary ethics

Consumers are demanding optimal animal welfare and, at the same time, want producers to stop using antibiotics needed to prevent, treat and control disease. "No-antibiotic policies ask us to violate every aspect of our veterinary oath," writes Suzanne Dougherty, DVM, MAM, DACPV, a consulting veterinarian in Alabama.



THE LAST WORD

Ignoring the 800-pound gorilla

With all the worries about avian influenza in the US and other major poultry markets, you'd think a magazine named *Poultry Health Today* would have made flu its cover story and surrounded the topic from every angle.

The editors told me they strongly considered doing just that. But after much discussion, they decided to ignore the 800-pound gorilla in the chicken house — at least for this edition.

Why the flagrant omission? The editors gave me two reasons.

Moving target

First, they were concerned about saturation. You can't pick up a monthly trade magazine or log on to a media website today without reading about the latest avian flu developments, they reasoned. Why duplicate those excellent efforts?

More important, the editors noted that while avian flu was a hot topic, there were still many other poultry diseases — coccidiosis, infectious bursal disease (IBD) and bronchitis, to name a few — that threaten the health and welfare of flocks every day, on every farm. Aren't *Poultry Health Today*'s readers still concerned about those diseases?

Their approach made sense to me — and even more so after I got to Boston for the 2015 American Association of Avian Pathologists (AAAP) conference. There I realized that of the more than 160 sessions and nearly 100 posters presented during the 4-day scientific program, less than 10% were focused on flu. The rest were devoted to gut health, Marek's, respiratory diseases, IBD, reovirus, *Salmonella, E. coli,* virology, diagnostics and welfare.

Granted, the call for abstracts for AAAP went out last fall — well before avian flu became the talk of the US poultry industry. Nevertheless, the AAAP's 2015 program served as a timely reminder that there are many other flock health and welfare issues that demand attention from the poultry industry and the media.

'Can't turn our backs'

As one practitioner at AAAP confided to a *Poultry Health Today* editor over a beer, "Sure, I'm worried sick about avian flu — an outbreak at our broiler farms would be devastating. But we can't turn our backs on all of the other bugs. They may not cause a farm to be quarantined, but their impact on flock health, welfare, and on profitability can be staggering."

Zoetis is pleased to sponsor *Poultry Health Today* and bring you this latest issue. Don't forget to visit poultryhealthtoday.com to sign up for weekly updates. And yes, you'll even find a few time-sensitive articles about avian flu.

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POULTRY HEALTH TODAY

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