Coccidiosis control without rotation hassles

Vaccinate with Coccivac®-B for year-round control of coccidiosis and eliminate in-feed ionophore rotation.

Go to www.spah.com/usa/poultry/Coccivac-B and learn how progressive poultry integrators are developing coccidiosis control programs for the 21st century.

Coccivac®-B

It's all you need.

[Innovative Solutions in Poultry Health]

Schering-Plough

NORTH AMERICA ISSUE 1

NEW STRATEGIES FOR ENHANCING POULTRY VALUE AND PERFORMANCE

COCCIFORUM'S

INTESTINAL health

16 Special Report

Innovative Solutions for Clostridial Infections

SPAH-PBU-500

cover story

16 **Special Report**

Symposium offers new ideas for managing gut diseases and promoting better intestinal health in commercial broilers.

up front

opinion

Dr. Charlie Broussard reflects on the 7-year evolution of *CocciForum* magazine, as well as the new scope and look of its exciting replacement, *Intestinal Health*.

postcard

Veterinarians, nutritionists and production managers from four continents flocked to Brazil recently for an informative symposium on intestinal health topics.

innovations

research watch

worth repeating

NEW STRATEGIES FOR
ENHANCING POULTRY VALUE
AND PERFORMANCE

ISSUE 1

COCCIFORUM'S

INTESTINAL health

spotlight

Energy conservation

Work by Oklahoma State's Dr. Robert Teeter is yielding exciting new strategies for optimizing bird nutrition and immunity.

7

Adding more value

12

Canada's Fisher Feeds has eliminated all in-feed antibiotics, including ionophores, from its broiler program.

Leaving its mark

Eimeria mivati causes gut lesions and mortality and may affect 35% of US poultry flocks.

39

(on the cover)

You can't tell from looking at these eggs in a western Canada hatchery, but these chicks will hatch with maternal protection against *Clostridium perfringens* type A, the primary organism responsible for necrotic enteritis in broiler chickens. For more on the revolutionary vaccine and other ideas for promoting better intestinal health, see the Special Report that begins on page 16. *Photo by Joseph Feeks*

opinion: "New look, new commitment"

Dr. Charlie Broussard says the poultry industry is developing an even greater understanding of nutrition's role in promoting intestinal health.

Welcome to the premier issue of CocciForum's *Intestinal Health*, a "new" magazine for the poultry industry, sponsored by Schering-Plough Animal Health.

I use the word "new" in quotation marks because, in reality, the magazine dates back to 2001, when we published our first issue of *CocciForum*, a magazine devoted to covering new strategies and ideas for coccidiosis management.

Rapid growth

CocciForum was well received worldwide and soon grew to include three separate regional editions, including an all-Spanish edition specifically for Latin America. But just as the magazine expanded, so did the industry's understanding of coccidiosis, necrotic enteritis, gangrenous dermatitis and other costly enteric diseases.

At about the same time, with the help of the IDEA concept (*CocciForum* No. 9), the poultry industry developed an even greater understanding of nutrition's role in promoting better gut health, improving performance and managing enteric diseases without antibiotics.

'Just as the magazine expanded, so did the industry's understanding of...costly enteric diseases.'

For that reason, the name *CocciForum* just didn't seem to be enough anymore, so we changed it to CocciForum's *Intestinal Health*.

Food for thought

More importantly, this edition of *Intestinal Health* contains lots of meaty articles that will help you implement an even better intestinal health program for your flocks — one that integrates good management, environmental factors, nutrition, supplements and vaccination.

Do you still need more information about promoting better intestinal health? This issue and past issues of *CocciForum* magazine are now available at www.thepoutrysite.com/intestinalhealth We're also developing a new *Intestinal Health*, web site that will become available in 2008.

Thanks for your support and enthusiasm for our publication. Please take a moment to complete the accompanying reply card and tell us what you think.

Charlie Broussard, DVM
Director, Poultry Technical Services
Schering-Plough Animal Health

Florianopolis

CocciForum Brazil 2007 challenged vets, nutritionists and producers to find new management strategies for enteric disease.

More than 140 poultry veterinarians, nutritionists and production managers from four continents flocked to Florianopolis, Brazil, in September for **CocciForum Brazil 2007**, an informative symposium on intestinal health topics.

Collectively, attendees managed 3 billion broilers, 20 million breeders and 16 million layers. The event, organized by Schering-Plough Animal Health, was held in conjunction with the Latin American Poultry Congress.

One key talk was delivered by Dr. Robert Teeter, a poultry nutritionist and researcher at Oklahoma State University, who noted that broilers experience most of their growth after 27 days.

"We've found that if the bird is hit with a coccidiosis challenge before that 27-day mark, it has time to make up for performance it's lost," he said. But, he added, coccidia challenges that occur from 27 days onward don't give birds enough time to recover lost growth. (See page 7 of this edition for more on this presentation.)

Other topics on the 2-day agenda: New strategies for controlling coccidiosis, enteritis and salmonella; optimizing performance and production costs in finisher feeds; managing growth-promoting antibiotics for best returns; and practical steps for revitalizing resistance-prone drugs for coccidiosis and other enteric diseases.

An in-depth report on the CocciForum Brazil 2007 appears in the current Latin American (Spanish)) edition of *Intestinal Health*, which is available from Schering-Plough Animal Health representatives or at www.thepoultrysite.com/intestinalhealth. More details from the Brazil meeting will also be reported in future English editions.

innovations

New ideas, trends, products and technologies

! Red poultry mites may hold key to reducing Salmonella in poultry and people

Bacteria that live inside red poultry mites might provide a new and effective way to prevent the spread of salmonella and other pathogens in chickens, says Dr. Olivier Sparagano of Newcastle University, United Kingdom.

Red poultry mites cause huge losses in layers, resulting in blood-spotted eggs that are unfit to sell. They can also cause anemia in chickens that leads to illness and a susceptibility to infections such as salmonella, which can be transmitted to people via eggs or broiler meat.

A new way of fighting the poultry mites is needed in part due to growing resistance to acaricides, Sparagano notes.

"If somehow we could develop a method to destabilize the symbiotic bacteria that we have discovered living inside the mites, therefore removing [their] beneficial effect, we could develop a new control method for the chicken red mite," Sparagano proposed in a talk given at the 2007 annual meeting of the Society for General Microbiology held last September in Edinburgh, UK.

There would be several other benefits besides a possible reduction in infections such as salmonella if Sparango and his colleagues are successful. The use of acaricide chemicals currently used to control the mites could be reduced; that in turn would reduce concerns about acaricide residues in eggs, which have been found, and there would be a reduction in cases of skin rashes and dermatitis in poultry workers, according to information from the Society for General Microbiology.

! New nutritional strategies, vaccines will be 'wave of the future' for broilers

Modernized nutritional strategies designed to suit the changing needs of broilers will be the wave of the future in broiler production, predicts Dr. José Ignacio Barragán Professor, University of Valencia, Spain.

"Instead of the usual starter, grower and finishing feeds designed to accommodate the administration of in-feed anticoccidials and their withdrawal times, we can use vaccines for coccidiosis control and take advantage of the updated nutritional strategies they allow," he says.

"Up until now, everybody has been talking about feed concentration, levels of energy and levels of protein. But there is more to it than that. We now understand that maximizing digestibility is even more important," Barragán says.

Nutrition should be designed to help build intestinal health early in life and to protect birds from mortality later in their lives, when losses are more costly due to the resources that have been invested, he says.

Some broiler producers, especially those who have been using the same nutritional approach for years, may find this new way of thinking difficult to embrace, but Barragán says that with new nutritional concepts, it is possible to reduce the concentration of the feed, maintain good performance and save money.

The nutrition plan he describes for birds vaccinated against coccidiosis emphasizes good digestibility during the starter phase, which is accomplished by enriching the characteristics of the starter feed by increasing the amino acid content.

Digestibility is also important in formulating effective second-stage feeds, he says. "That may mean increasing the quality of the raw materials we're using to not only maintain growth but intestinal health by reducing the amount of residual bacteria left in the gut — bacteria that can nurture harmful microorganisms."

These changes may increase the cost of the starter and grower phases, but used in concert with vaccines, growers can recoup those costs and more. "The birds will save [farms] money in the end because they will not need expensive finishing feed," he says.

research watch

Dietary lactose reduces lesions from necrotic enteritis in broilers

Including lactose in the diet of broilers might help control the clinical signs of necrotic enteritis, which has been on the rise in countries and commercial companies no longer using antibiotic growth promoters, say investigators.

In an experiment, day-old broilers were fed either a non-lactose control diet, a diet with 2.5% lactose or a diet with 4.5% lactose. On day 17, they received oral doses of *Clostridium perfringens*, the bacterium that causes necrotic enteritis, for 3 consecutive days, say J. L. McReynolds of the Southern Plains Agricultural Research Center, Agricultural Research Service, USDA, and associates.

Next the investigators evaluated intestinal lesions associated with necrotic enteritis. Lesion scores were significantly lower in birds that received 2.5% lactose compared to the other two groups, the investigators say.

"These experiments suggest that lactose could be used as a potential alternative to growth-promoting antibiotics to help control this costly disease," they say in a published article (*Poultry Science*, 86(8): 1656-1661 2007).

Previous studies by the same investigators have indicated that lactose might also reduce salmonella and *C. perfringens* in the ceca of poultry.

Risk factors for necrotic enteritis identified

Necrotic enteritis, a growing problem in the poultry industry, is not only linked to coccidiosis and wet litter, it is also associated with the use of ammonia and the presence of plasterboard walls, according to researchers from the University of Liverpool.

To determine the prevalence and risk factors for necrotic enteritis in broilers, a survey of managers was conducted among 857 farms rearing broilers for nine poultry companies in the United Kingdom. Additional information on disease occurrence was obtained from veterinary postmortem reports.

The results, based on a 75% response rate, indicated that over 32% of the managers had observed a case of necrotic enteritis in at least one flock during 2001, say P. G. Hermans and K. L. Morgan in a published article (*Avian Pathology*, February 2007).

It comes as no surprise that they found a "strong association" between necrotic enteritis and the presence of wet litter and coccidiosis, but they also found that the use of ammonia as a disinfectant for coccidial oocysts appeared to be an independent risk factor for necrotic enteritis. In addition, there was a positive association between the use of plasterboard walls in poultry houses and the occurrence of necrotic enteritis, the investigators say.

[Editor's note: For more on necrotic enteritis, see the Special Report beginning on page 12.]

Impact of new, used litter on *Eimeria maxima* immunity studied*

Using new or used litter appears to make little difference in the acquisition of immunity to *Eimeria maxima* among newly hatched chicks, according to a University of Arkansas study.

Investigators conducted two experiments with chickens that were infected with 100 oocysts of *E. maxima* 18 hours after hatching. The chickens were reared in floor pens, where they were in contact with their droppings.

In the first experiment, birds were placed on new litter. In the second experiment, they were placed on new litter or on used litter obtained from the first experiment. In both studies, the birds were challenged periodically with *E. maxima* oocysts, then immunity was assessed based on weight gain and oocyst production, said the investigators, Drs. S. Rayavarapu and H. David Chapman.

"Judged by weight gain following challenge, no significant difference in the acquisition of immunity was observed whether birds were reared on new or reused litter," the investigators concluded.

**From the Poultry Science Association annual meeting held last July in San Antonio.*

Energy Conservation

New research-driven insights on how chickens utilize feedstuffs can help broiler producers develop new strategies for getting the biggest bang from nutritional programs while improving flock health.

Some of those insights were the focus of a presentation delivered by poultry nutritionist and researcher Dr. Robert Teeter, a professor and nutritionist sat Oklahoma State University, at a recent CocciForum symposium in Florianopolis, Brazil.

Teeter pointed out that energy obtained from feed is used to maintain tissue and organs, regulate body temperature, develop immunity and support various physical activities, including acquiring more food to support the growth curve.

After those essential needs have been satisfied, whatever energy that remains is devoted to growth — or at least that's the way it's supposed to work in a perfect world.

In reality, Teeter said, various stressors – especially disease – can significantly drain energy reserves and rob birds of nutrients they need to achieve optimal growth. Stressors can also work together to have a negative effect. "It's the combination of stressors that have the most impact," he said.

Bigger impact with age

While minimizing stress as much as possible is an important goal for broiler producers, paying attention to the *timing* of these stressors is also crucial, Teeter said. "Early exposure to stress is, of course, detrimental, but it has a much smaller overall impact in terms of weight gain or feed use," he said.

The growth curve for broilers accelerates rapidly after about 27 days, Teeter explained. "If the bird is hit with a stressor before that 27-day mark, it has time remaining to make up for any performance it loses," he said. "But late stressors that happen from 27 days onward simply don't give the bird enough time to recover lost growth."

For years Teeter and his colleagues have been studying birds placed in high-tech metabolic chambers that allow the researchers to measure even subtle changes in the birds' energy intake and utilization. As part of that work, they

developed statistical models that reliably predict metabolizable energy consumption in disease-free birds.

Challenge of disease

But what about energy consumption in birds challenged by disease?

According to Teeter, coccidiosis is one of the most significant disease stressors that commercial broilers face. Using tests in his metabolic chambers, his team contrasted healthy with infected birds in terms of growth rate and final mass, average daily gain (ADG), feed efficiency, energy loss from waste excretion, and energy use for maintaining bodily functions.

In past work, Teeter's group confirmed that coccidia — the parasitic organisms that cause coccidiosis — do, indeed, have a significant detrimental effect on all those parameters. However, more recently they have been digging more deeply into how the timing of coccidia challenge affects those measurements.

"Broilers don't grow in a strictly linear way," Teeter reminded the audience of veterinarians, nutritionists and production managers. "Most of their growth takes place after 27 days, the latter part of their growth curve." (Figure 1). Based on his findings, he thinks the timing of the "coccidiosis insult" makes a significant difference in how birds utilize energy for growth.

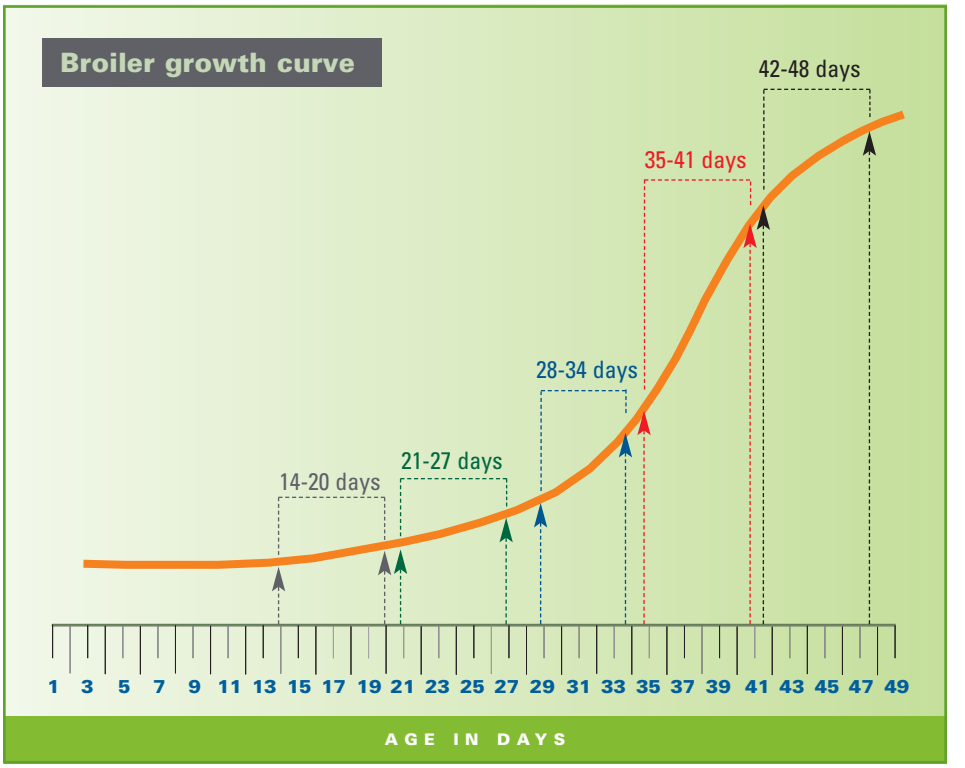


Figure 1. Broiler growth curve, 14-48 days.

Teeter's group performed a study in which they assigned a group of broilers to either an experimental or control group. The experimental group was challenged with three common coccidia pathogens — *Eimeria tenella, Eimeria acervulina* and *Eimeria maxima* – and placed in the metabolic chambers for 6 days to track performance, body composition, metabolic heat production, calorie expenditure and calorie loss due to excretion. Control birds were administered only a sterile solution.

After 6 days of collecting data in the chamber, researchers euthanized and necropsied the birds, ranking lesions for severity using a standardized system.

Teeter reported that coccidia challenge had a negative effect on performance of all birds, with the highest lesion scores correlating with poorest performance. That was especially true in birds that received a mixed challenge of at least two species of coccidia.

More surprising, however, was that even low lesion scores were associated with a negative impact on performance, especially as birds neared the end of their growth curve.

Late coccidiosis exacts heaviest toll

To more fully assess the importance of timing of coccidiosis challenge, Teeter's group compared two groups of broilers — one reared in an environment that provided a low level coccidia challenge delivered by a live coccidiosis vaccine (Coccivac-B); the other received no challenge.

At 20 days of age, researchers tallied performance numbers and necropsied 50% of the birds. The rest were reared for the full grow-out period of 48 days while researchers monitored their performance.

"In the group of birds necropsied at 20 days, microscopic lesion scores were different from controls in every case, even for this mild level of exposure," Teeter said.

Performance of early challenged birds

Age (days)	Challenge	Live wt. (g)	FCR
20	None	791[a] (1.74 lb)	2.10[b]
20	Yes	750[b] (1.65 lb)	2.18[a]

FCR = Feed conversion ratio

Data in columns with superscript are statistically significant ($P < 0.05$).

Table 1. Performance of early-challenged birds, 20 days.

Final performance of early challenged birds

Age (days)	Challenge	Live wt. (Kg)	FCR
48	None	3.57[a] (7.87 lb)	2.12[a]
48	Yes	3.56[a] (7.84 lb)	2.16[a]

FCR = Feed conversion ratio

Data in columns with superscript are statistically significant ($P < 0.05$).

Table 2. Final performance of early-challenged birds, 48 days.

Performance indicators such as live weight and feed conversion also reflected some negative effects of early cocci challenge. However, Teeter emphasized, by 48 days the birds had overcome that reduction in performance — a process known as compensatory gain (Tables 1 and 2).

"At that point the average weight of the birds was not different – about 3.56 to 3.57 kg (7.84 to 7.87 pounds) and the feed-conversion rate was also the same as controls." Overall, he said that the coccidia-challenged birds regained all of their body mass and there was no significant difference in feed conversion between them and the non-challenged controls.

Measuring lost growth

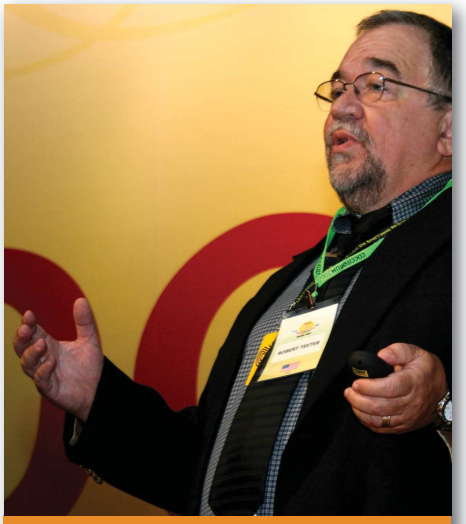
Teeter also told the audience about a useful set of mathematical modeling tools they've developed to track how and when birds metabolize feedstuff — a measurement he calls "metabolizable energy consumption."

These models assume that birds are raised in disease-free conditions. If birds expend

more energy than what's predicted by the disease-free model, it suggests that energy is being lost — either as additional energy needed for maintenance (e.g., generating extra body heat, mounting immune responses, increased physical activity) or possibly from decreased digestibility of the ration itself or perhaps extra energy lost in excreta.

He said many of his group's findings confirm the importance of producers guarding against late coccidia challenge. "When we use these tools to look at the data we've collected," he said, "there is a constant that seems to emerge from the numbers — that is, for each increase in microscopic coccidiosis score, ADG decreases approximately 1.5% of body weight."

That means, he said, that for a 2-kg (4.4-pound) bird with a lesion score of 1, the loss in ADG would be expected to be about 30 grams (0.066 pound) per day. For a similar size bird with a lesion score of 2, the loss doubles to about 60 grams (0.132 pound) per day.



> "Even minor lesions can cause huge losses."
>
> DR. ROBERT TEETER

These mathematical tools also show that feed efficiency suffers in the presence of coccidiosis.

"For each increase in visual coccidiosis score, feed efficiency decreases approximately 0.0084% per gram (0.002 pound) of live weight," he said, noting that nearly half of feed eaten by birds is consumed during the final 2 weeks before processing.

"So even with a coccidiosis score of 1, the impact on final feed conversion is going to be enormous."

Field experience confirms lab results

Experience gained in real-world settings lends credence to Teeter's findings about the potentially devastating effects of late cocci challenge.

In one operation in Ontario, Canada, with Ross 308 birds that were not vaccinated against coccidiosis, very high oocyst counts were noted around day 29, though no symptoms of coccidiosis such as bloody droppings were present.

When expected weights for the Ross 308 birds (as provided by the breeding company) were plotted on a graph along with the actual weight of the birds, a significant loss of growth – culminating in zero growth — was seen at day 39 onward (Figure 2). Observers suspect some of the loss in growth may have been due to coexisting necrotic enteritis, though no clinical evidence of that was seen.

In later flocks the Canadian producer decided to use a live coccidiosis vaccine (Coccivac-B) to provide early cocci challenge. The results were dramatic. Late weight loss was avoided due to earlier development of immunity (Figure 3).

Such accumulating data, Teeter says, are powerful. "I've been awe-struck at the tremendous impact late-stage coccidiosis has on performance."

He sums up, "It is critical for broiler producers to make a routine analysis of the timing and severity of coccidiosis challenge because, if it happens early, the birds have time to recover. If it happens late, toward the end of the production cycle, there's just not enough time for them to recover, and even minor lesions can cause huge losses."

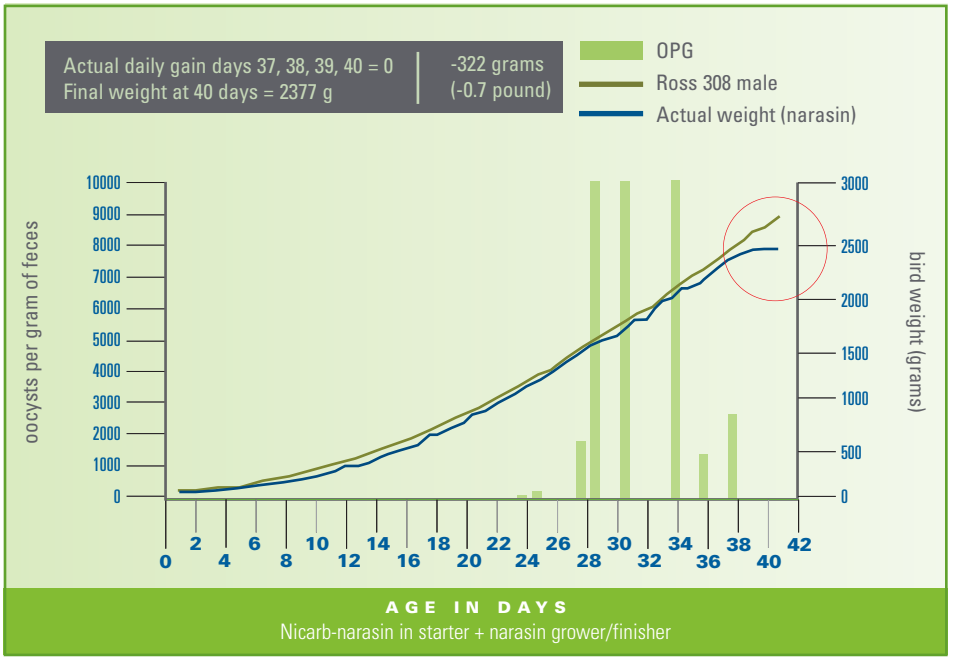


Figure 2. Ontario-raised Ross 308s: Impact of coccidia challenge on expected weights.

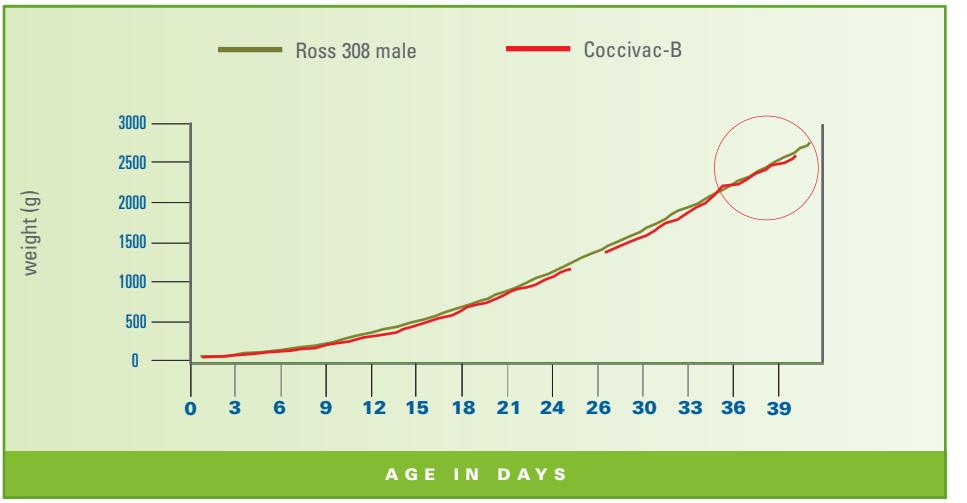


Figure 3. Actual weight of birds vaccinated with Coccivac-B vs. Ross 308 standard (same house, next cycle), August-September 2007.

Adding More Value

Nearly 3 years ago, Dr. Rae Fischer made what some people in the broiler industry might have called a very brave decision. Others might have said it was foolhardy.

The innovative CEO of Fisher Feeds[1], Listowel, Ontario, decided to stop using in-feed anticoccidials at his company's feed mill, which produces 100,000 tons of feed per year – about two-thirds for poultry.

About half of the poultry feed produced at the mill supplies his family's poultry operation, Bert Fisher Farms, and its contract growers.

His strategy, Fischer explained at the time, was to put more emphasis on nutrition, particularly in the early stages of chick development, and rely more on vaccination with Coccivac-B to keep coccidiosis in check.

Emphasis on nutrition

"This may sound funny coming from someone who owns and operates a feed mill, but I just hate putting chemicals and antibiotics in the feed," he told *CocciForum* magazine in 2005 (Issue 11). "I want the emphasis to be on good nutrition programs, with quality raw materials, ingredients and processing."

He added, "As a veterinarian, I want to see these decisions made on science, not emotion or propaganda. But either way, if[poultry raised without antibiotics] is what the consumer wants, somebody's going to have to produce it. We need to be ready for drug-free production, and that's one of the reasons we wanted to start vaccinating."

Fischer still separates broilers by sex, growing cockerels to 2.5 kg (5.53 lbs) in 38 days, and pullets to 2.4 kg (5.30 lbs) in 40 days. After a few weeks of his new program, he knew he was onto something good when he saw that birds vaccinated for coccidiosis performed as well or better than birds that received an in-feed anticoccidial.

"We never saw the dramatic drop in performance that we were looking for," Fischer reported at the time, "probably because our nutrition program helped to condition the gut and help it tolerate the challenge from the vaccine."

All or nothing

So how's his new program working more than 2 years later? Apparently very well.

continued

[1]Dr. Rae Fischer and his company, Fisher Feeds, have similar names, but they are spelled differently.

Encouraged by the strong performance of his flocks, Fischer decided to take the next big step and get rid of *all* in-feed antibiotics — a move he thought would allow his operation to focus even more on good management, nutrition and vaccination as a means of promoting good intestinal health. He says he's not regretting the decision — and neither are his birds, which have not experienced any significant setbacks in health, performance or profitability.

Two factors drove Fischer's decision:

- **Consumer demand.** He was acutely aware of shifting consumer perceptions and the growing demand for birds raised without antibiotics. (See accompanying article.)

- **Better science.** Fischer felt that dropping in-feed antibiotics was simply better science. With a degree in veterinary medicine, Fischer wasn't convinced that medicated feed was the best way to keep enteric disease in check. He was also concerned about reports from other markets about growing resistance, which reportedly developed after prolonged use of in-feed anticoccidials. Closer to home, he felt some feed medications were losing their effectiveness.

> "We're always looking to add more value that's the key."
>
> DR. RAE FISCHER

"We've also been watching the regulatory climate," he says. "There aren't any new in-feed anticoccidials being developed, and the trend in Europe — a market that's very similar to ours in Canada — has been to ban some drugs altogether. We don't have as many tools available to us as we did 5 or 10 years ago. And now, there's growing pressure from regulators and consumers to reduce and even eliminate drugs from the feed.

"We saw this situation as an opportunity to differentiate our product and add value," he explains. "We also wanted to prepare ourselves for a market that was coming up."

Focus on first 7 days

Fischer's feed formulations are proprietary, so he can't get into details about the changes he's made in his nutrition program to improve intestinal health.

"What I can tell you is that we have to be far more specific on our nutrition and more precise in our management," he says. "With antibiotics, you can have some insult to the livestock and still not have a visible disease problem. When you go drug-free, you have to remove all those stresses that antibiotics might protect you from."

Adding More Value

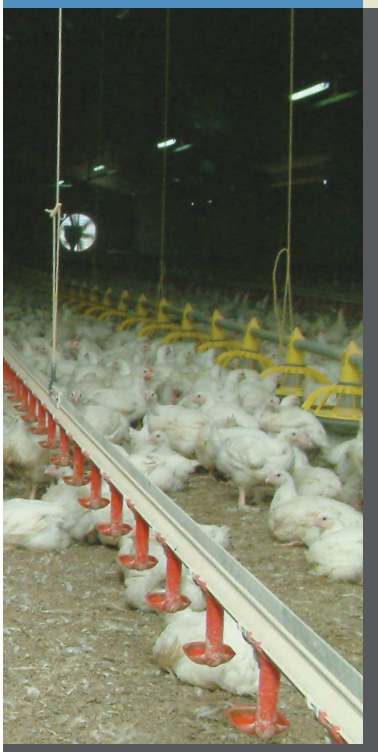
Fischer says the first 7 days of a bird's life are the most critical for developing immunity. Under optimum conditions, he says chicks can grow to 5 times their initial body weight in their first 7 days of life. Fischer also says that research shows that the weight of 5- to 7-week-old broilers has a direct linear relationship to the first week of rearing, regardless of breeder age or day-old chick weight (Pezeshkian, 2002). His primary genetics suppliers, Aviagen and Cobb-Vantress, have also told him that 1 extra gram of weight at 7 days means an extra 5 to 7 grams at market weight.

"Even with conventional production, focusing on the first 7 days will give you an advantage because it will broaden your protection and health status," Fischer says. "The first 7 days are extremely important in antibiotic-free production. You carry that thought process out a little farther, extend it for the life of the birds and do absolutely everything you can to minimize any insult that might be thrown in their way."

As a feed manufacturer, Fischer is in the perfect position to optimize the nutrition component of a vaccine-based intestinal

Booming market in North America for 'natural and organic'

It's easy to see why Dr. Rae Fischer wants to produce drug-free birds.



Progressive poultry companies are reducing or eliminating antibiotics to meet consumer demand.

Studies commissioned by the Organic Agriculture Centre of Canada show $1 billion is a conservative estimate for total retail sales of certified organic products through all market channels in 2006.

According to data provided by The Nielsen Company, Canadian supermarkets sold $412 million worth of certified organic food products in 2006. This represented a 28% increase from the previous year, with 31% growth in pre-packaged products and 22% growth in fresh product.

Although organic meat has a relatively small market in Canada, it is a rapidly expanding segment showing gains of 81% from 2005 to 2006 at a time when raw meat sales overall declined by 2%. Organic poultry (chicken and turkey) accounted for 61.5% of the total organic raw meat.

A similar trend is taking place south of Canada's border, but on a much grander scale.

U.S. organic food sales totaled nearly $17 billion in 2006, up 22% over previous year, according to preliminary findings from the Organic Trade Association's 2007 Manufacturers Survey. About 31% percent of overall organic sales in 2006 were through mainstream supermarkets and grocery stores.

While industry definitions for "organic" and "natural" are still being debated worldwide, progressive poultry companies in Europe and, more recently, the United States and Canada are reducing or eliminating antibiotics from their commercial operations to meet the challenges presented by health-conscious consumers willing to pay a premium for poultry raised without feed medications.

Adding More Value

health program, but he says that's not the only component.

"We've been far more precise on our environmental controls – temperature, air movement, humidity, lighting – to provide that optimal environment and less opportunity for a challenge," he explains.

Threat from NE

Another ever-present issue for poultry producers is necrotic enteritis, particularly in drug-free programs. "When you take out the effects of antibiotics or ionophores, you need to take steps both nutritionally and management-wise that would reduce any kind of clostridium effect," he says.

He is encouraged by preliminary results with a new vaccine for necrotic enteritis — officially known as *Clostridium perfringens* type A toxoid while it awaits full licensure — that was developed by Schering-Plough Animal Health and is the first product of its kind for poultry. (See related articles on page 16 of this issue.) "We've had some promising results with it, and certainly it will be one of the tools we would want to use," Fischer said. "We're very optimistic on that."

This extra attention to detail required for a coccidiosis vaccination program – nutrition and environmental management – has an inevitable impact on production costs. There are also processor costs associated with segregating and documenting birds from drug-free production. But Fischer does not see these costs as significant, especially in the context of cost increases for other inputs, most notably feed.

While the poultry industry strives for more efficiency, its efforts could be blindsided by the impact of ethanol demand on corn supply – a trend that's rippling through all livestock industries.

"We've looked at some of the byproducts and whether or not we can utilize them, but we've stayed away from them until this point because of inconsistencies and other issues. It's something we may have to look at again, and maybe that is another challenge we will have to face."

And while it's not a welcome development, one can't help but think that it's another challenge Fischer would be quite happy to take on.

Commanding premiums

While there will always be a segment of the market that is very price sensitive, Fischer says his company is focusing on areas it can control — like commanding a premium on a high percentage of his farm's production. Pleased with drug-free experiences so far, the restless innovator already has his eye on other opportunities to keep his operation at the head of the pack.

One possibility is the use of Omega 3-enriched rations to increase the availability of Omega 3 for consumers. It's an attractive goal, but a tough nut to crack, Fischer admits. The challenge right now is that the Omega 3 accumulates in the birds' subcutaneous fat. This tends to be discarded along with the skin when chicken is eaten by health-conscious consumers — the same people who would be attracted by Omega 3 — enriched product in the first place. Consumers may well find a more convenient delivery system for Omega 3 in future, but Fischer isn't ready to let go of the idea just yet.

"We're always looking to add more value — that's the key," he says

Special Report

Intestinal Health 2007

Innovative Solutions for Clostridial Infections

Combining hard work in the laboratory with hard data from the field, poultry researchers, veterinarians and nutritionists are gaining new insights into gut diseases that affect commercial birds.

Some of the most intriguing, and potentially valuable, insights center around how several diseases commonly seen in broilers — coccidiosis, necrotic enteritis and gangrenous dermatitis, to name a few — interact with each other.

Specialists say that poultry producers who understand those disease interactions and, more importantly, factor them into their long-range planning, can further improve bird health and performance while reducing or even eliminating in-feed drugs.

To help the poultry industry meet this goal, Schering-Plough Animal Health sponsored "Intestinal Health 2007: Innovative Solutions for Clostridial Infections," a 2-day symposium held in Orlando that featured talks by several leading specialists in the field.

In this special report, CocciForum's *Intestinal Health* takes a closer look at what's been learned recently about intestinal disease interactions in poultry — and what they mean for broiler producers.

To listen to highlights from the symposium, go to the Newsroom section of www.netvaxforpoultry.com and click on Podcasts.

Hofacre:

'Necrotic enteritis... a big performance issue'

So we re not just talking about necrotic enteritis as a mortality issue. It s a big performance issue.

DR. CHUCK HOFACRE

It's no secret that necrotic enteritis is a big problem in poultry. The ubiquitous disease, caused by the soil-borne organism *Clostridium perfringens*, costs the world's poultry producers some $2 billion every year or as much as 5 cents per bird, according to published reports.

The difference today, specialists say, is that there's more of it, thanks in part to the declining use of antibiotic growth promoters and in-feed anticoccidials, which helped to manage the disease. Hoping to gain more insights on the chronic bug, researchers are also taking a second look at control measures.

Dr. Chuck Hofacre — a professor and director of clinical services at the University of Georgia who's been looking into the causes and cures of necrotic enteritis (NE) for the past 10 years — said that putting this new information to work can help producers raise healthier and more profitable birds.

Fewer AGPs, more necrotic enteritis

In his presentation, Hofacre began by pointing out that until recently, necrotic enteritis hadn't been that big a problem in most conventional broiler operations. That's partly because the antibiotic growth promoters (AGPs) used in many flocks had an added, albeit unintended, effect: they helped control clostridium. Now that more growers are bowing to consumer pressure to get AGPs out of their poultry, necrotic enteritis has been gaining a foothold.

Even when NE doesn't kill birds, it can have a devastating effect on performance. "If we don't do something to prevent necrotic enteritis," said Hofacre, "we're going to have less feed-efficient birds, and we're going to have lower body weight birds. So we're not just talking about necrotic enteritis as a mortality issue. It's also a big performance issue."

One of the most important findings that's come to light in recent research is that the mix of both "good" and "bad" bacteria in the intestinal tract of chickens has a significant impact — not only on NE, but also on birds' overall health (Figure 1). He identified several ways to control that mix.

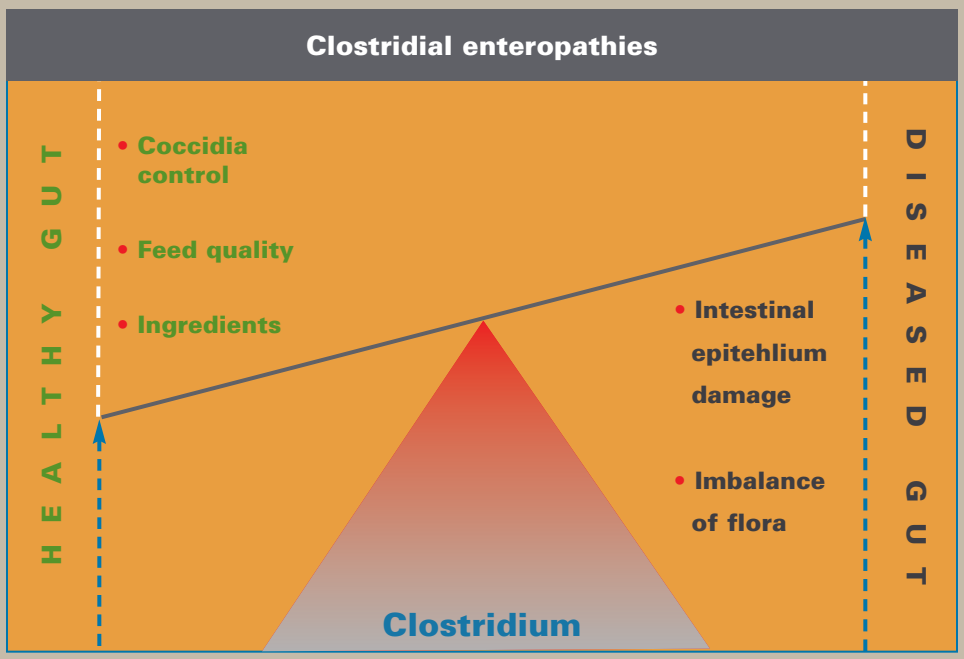


Figure 1. A mix of "good" and "bad" bacteria in the intestinal tract of chickens can significantly impact necrotic enteritis and overall health of the birds.

One is by paying close attention to the composition and quality of foodstuffs. Grains that contain a significant amount of non-soluble fiber, such as wheat, barley or oats, can predispose birds to NE. Growers need to keep in mind, Hofacre said, that some intestinal bacteria thrive on certain foods, while others don't.

For example, in Canada, poultry growers tend to rely on plentiful supplies of wheat to grow their birds. Wheat contains high levels of non-starch polysaccharides, bio-chemical components that chickens can't digest. Some types of intestinal bacteria, including *C. perfringens*, which produces the toxin associated with NE — thrive on polysaccharides.

Animal byproducts in feedstuffs can be a predisposing factor, too. Research has shown that some blended feeds that contain fish or bone meal have thousands of clostridium spores per gram. That means broilers may be getting a heavy dose of clostridia along with their food.

But, Hofacre points out, the economic realities of running broiler operations often make some give-and-take necessary when choosing feed. Readily available and lower-cost ingredients sometimes make more sense in the long run. "So those farmers in Canada are not about to stop using wheat," he said.

And there's no need to shun wheat, either, he said. "These differences in the way that feeds affect the intestinal flora can be managed," Hofacre added. "Growers just need to understand how all the factors that influence necrotic enteritis fit together."

For example, during periods of heavy coccidia challenge, when the birds have more stress on the gut, he urges producers to consider cutting down on ingredients in the feed that might cause problems.

PCR: A useful tool

One tool that researchers have been using recently to help unlock the mysteries of intestinal health is polymerase chain reaction (PCR) technology — "the same technology the good guys use on TV's CSI

Hofacre

to solve crimes," Hofacre said. With PCR, poultry scientists can analyze the content of chickens' intestines to find out exactly what bacteria are there and in what proportions.

For most of the life of a broiler, *C. perfringens*, along with other non- toxic strains of clostridium, rank second — behind the bacterium *lacto bacillus* — in the competition among gut microflora. One of the reasons *C. perfringens* has such a strong presence in the gut is that the enzymes it produces feed on endothelial mucous.

When the lining of the intestine is damaged, even minimally, by irritation from a disease organism, it produces mucous. Over the eons that *C. perfringens* has evolved, explained Hofacre, the bacterium learned to essentially feed off the mucous. The result is that clostridia grow faster, produce more toxins, more damage and more mucous, and the cycle just continues.

Maintaining a protective shield

What steps can broiler producers take to break the cycle?

First and foremost, emphasized Hofacre, producers need to begin thinking of the microflora of the gut as a protective shield that, if it contains a healthy mix of organisms, can help protect the delicate lining of the intestine from damage. A vital component in controlling NE, therefore, is to make sure the mix of microflora stays tilted to the healthy types.

> if we re going to produce a product without any antibiotics, then we re going to have to look at other ways to control coccidia.

One way to do that, he said, is to supplement the feed with natural products such as organic acids, which help promote a healthy balance of gut microflora.

Another is cleaning and disinfecting the house between flocks. That's especially true in operations that have a history of NE. Still another is keeping the moisture content in the litter down to a healthy level, since increased moisture raises the risk for NE.

Perhaps *the* key component in heading off necrotic enteritis is the use of good coccidiosis control, which makes the gut less vulnerable.

"We've controlled coccidia with chemicals and drugs, and we'll continue to do that," Hofacre said. But, once again acknowledging mounting consumer pressure to cut down on these feed additives in food production, he added "if we're going to produce a product without any antibiotics, then we're going to have to look at other ways to control coccidia."

Schrader:

'Incidence of necrotic enteritis was significantly lower'

A toxoid is a molecule that s still able to produce an immune response but is no longer capable of causing disease.

DR. JOAN SCHRADER

In response to increasing consumer and regulatory pressures to get drugs out of the food chain, broiler companies are reducing or even eliminating antibiotics and growth promoters. In doing so, many are attracting new customers willing to pay a premium for antibiotic-free birds. But, without drugs on board to protect their flocks, producers are beginning to see serious economic losses from necrotic enteritis.

At least one animal health company has recognized the need for alternatives to managing necrotic enteritis and has been working feverishly to come up with an innovative solution.

Dr. Joan S. Schrader, a research scientist for Schering-Plough Animal Health, told symposium attendees about a novel new vaccine specially designed to combat necrotic enteritis in poultry. She also gave them an overview of some of the trials leading up to the vaccine's conditional approval by USDA, which regulates biological products.

The product is currently known as *Clostridium perfringens* type A toxoid. She explained that Schering-Plough Animal Health has already met the regulatory agency's criteria for bird, human and environmental safety. Full license will be granted pending the outcome of efficacy trials, which are currently under way. In the meantime, many producers are already using the *Clostridium perfringens* type A toxoid to manage necrotic enteritis in broilers.

New vaccine builds on earlier work in other species

Shrader noted that Schering-Plough is hardly a newcomer in the development of clostridial vaccines. "The company began manufacture of clostridial vaccines for animals in the 1960s, so now we now have more than 40 years of experience in developing clostridial vaccines for cattle and sheep," she reported.

Necrotic Enteritis Protection – *pass it on!*

INTRODUCING

Clostridium perfringens Type A, Toxoid

for the control of necrotic enteritis in broilers

- *PROTECT YOUR FLOCKS WITHOUT USING ANTIBIOTIC GROWTH PROMOTERS*
  Vaccinate breeders and protect broilers through passive transfer of maternal antibodies against alpha toxin.
- *BEWARE OF SUBCLINICAL NECROTIC ENTERITIS!*
  Field trials with *C. perfringens* type A toxoid in over 26 million broilers showed improved livability, feed conversion and production costs over traditional treatments – even when no clinical symptoms were present.*

Contact your Schering-Plough Animal Health representative or go to www.necroticenteritis.com to learn more about necrotic enteritis protection.

| Innovative Solutions in Poultry Health |

*References and data on file


Visit our new website today at:
www.netvaxforpoultry.com
Schering-Plough

Schrader

As she sees it, the new vaccine for poultry is just a natural extension of that previous work.

Schrader, who served as the lead scientist on the project, said that she and her team tested numerous vaccine candidates before coming up with a suitable formulation. She said that clostridial disease in poultry is caused by the alpha toxin that is produced by *Clostridium perfringens* types A and C. Type A is by far the more common of the two, accounting for more than 95% of NE in poultry.

"The new vaccine is made from *C. perfringens* type A's alpha toxin that is inactivated into a toxoid," she added. "A toxoid is a molecule that's still able to produce an immune response but is no longer capable of causing disease."

Progeny protected by passive immunity

The NE toxoid is administered to hens at 10 to 15 weeks of age, then again at 17 to 20 weeks of age. It triggers antibody titers against the alpha toxin. Those antibodies are then transferred to the hen's progeny — a process known as passive immunity.

> We found that the incidence of necrotic enteritis was significantly lower in all of the vaccinated groups as compared to the control

To find out how long immunity lasts in vaccinated hens, Schrader and her team undertook a series of studies. They vaccinated the hens once, then followed that with the booster a few weeks later. Then they monitored the birds through the onset of lay, collected eggs during the early, mid and later portions of the laying cycle, and tested both the sera and egg yolks from the hens for antibody to the alpha toxin. Results from those studies were compared with controls.

"We had no titer in the sera of hens that were not vaccinated, but in the vaccinated hens, we had significantly higher titers, both at 35 weeks of age, then again when we re-tested them at 55 weeks," she said. "We tested egg yolks at 33 weeks of hen age, and 78 weeks of hen age, and we had significant titers out to 78 weeks of age."

Encouraged by those results, Schrader's team took the next step and tested the progeny of the hens. They set the eggs, hatched the chicks, and then fed the young birds a high-protein fishmeal diet designed to irritate the gut, which can promote necrotic enteritis. The birds were then challenged with *C. perfringens* type A on 3 consecutive days — 19, 20, and 21 — and then necropsied on days 22 and 23.

"We found that the incidence of necrotic enteritis was significantly lower in all of the vaccinated groups as compared to the control groups," she reported. "And that was in chicks that were hatched from hens that were 32, 52 and 65 weeks of age. (Figure 1) "

The researchers also compared necrotic enteritis lesion scores for vaccinated vs. control progeny and found that vaccinated birds had significantly lower scores than did controls.

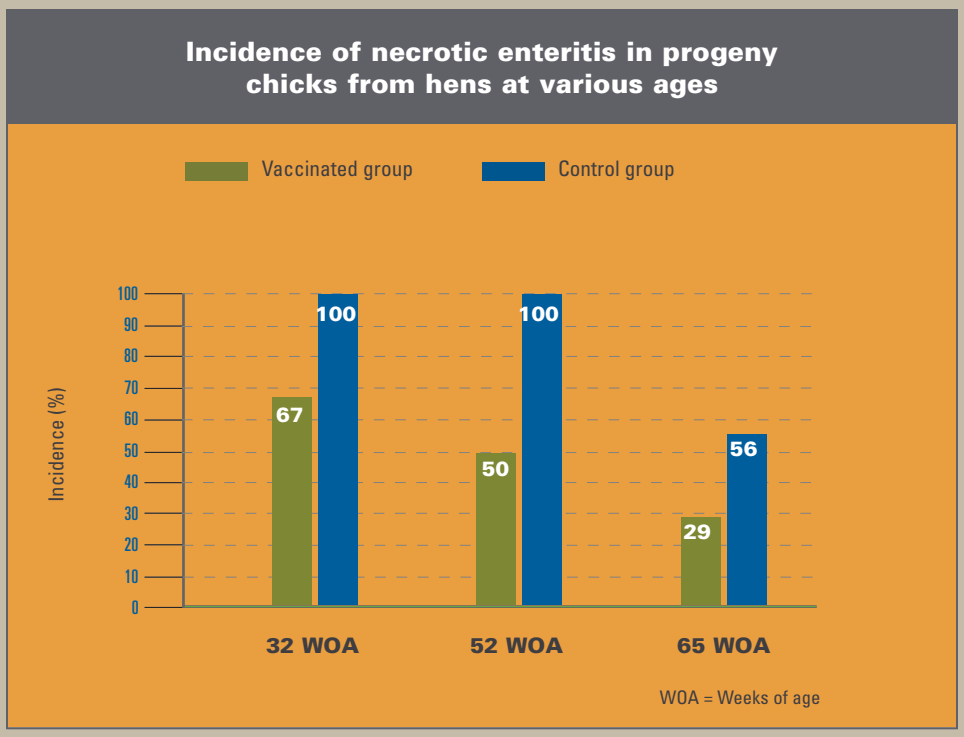


Figure 1. Incidence of necrotic enteritis was significantly lower in all of the vaccinated groups.

Summing up her presentation, Schrader said the NE toxoid induced a significant antibody response in the sera of hens administered the vaccine and that those antibodies persisted through 78 weeks of age. Eggs from the vaccinated hens showed significant antibody titers through 65 weeks of age.

"We also found that that the NE toxoid produced no tissue reactions at the injection sites, was found safe when used under field conditions and, most importantly, the progeny of the hens vaccinated with the NE toxoid were protected from necrotic enteritis challenge," she said.

...the progeny of the hens vaccinated with the NE toxoid were protected from necrotic enteritis challenge

Collett:

'Avoid perfect conditions for necrotic enteritis to develop'

We know that clostridial organisms in the small intestine, once they get access to nutrients, can replicate very quickly.

DR. STEPHEN COLLETT

Poultry producers who want to improve bird performance through natural means should bone up on the chicken's anatomy, says Dr. Stephen Collett, a nutritionist and professor at the University of Georgia.

At the Orlando meeting, Collett gave the audience a quick and practical overview of chicken anatomy, focusing on the digestive tract. His talk made it clear that growers who develop a better understanding of gut anatomy and put that knowledge to use can produce healthier birds and grow them faster.

Collett emphasized that early physiologic development of a bird is crucial for ensuring good growth throughout its life.

"That includes the development of normal intestinal flora and then getting a good interaction between the flora and the microvilli that line the intestinal tract," he said.

Microvilli are the tiny, hair-like structures that do most of the work of absorbing nutrients from food. They can be very significantly damaged early in life by toxins produced by *Clostridium perfringens*, the organism that causes necrotic enteritis (NE). When that kind of damage occurs, the bird's ability to absorb food is seriously compromised and it may never fully recover and meet its genetic potential in terms of performance or efficiency.

Cecum plays an important role

Collett pointed out that even though the upper part of the digestive tract — the ileum or small intestine — does much of the work of absorbing nutrients from food, the other end of the tract — the cecum — plays an important role, too.

"The hind part of the gut, or the cecum, is much more sensitive to antigenic stimulation," he said. "When we feed various kinds of diets to birds early on, it's very important to consider not only the digestibility of the proteins those feeds contain, but also the solubility of the protein. That's because soluble protein will move through the gut much more rapidly."

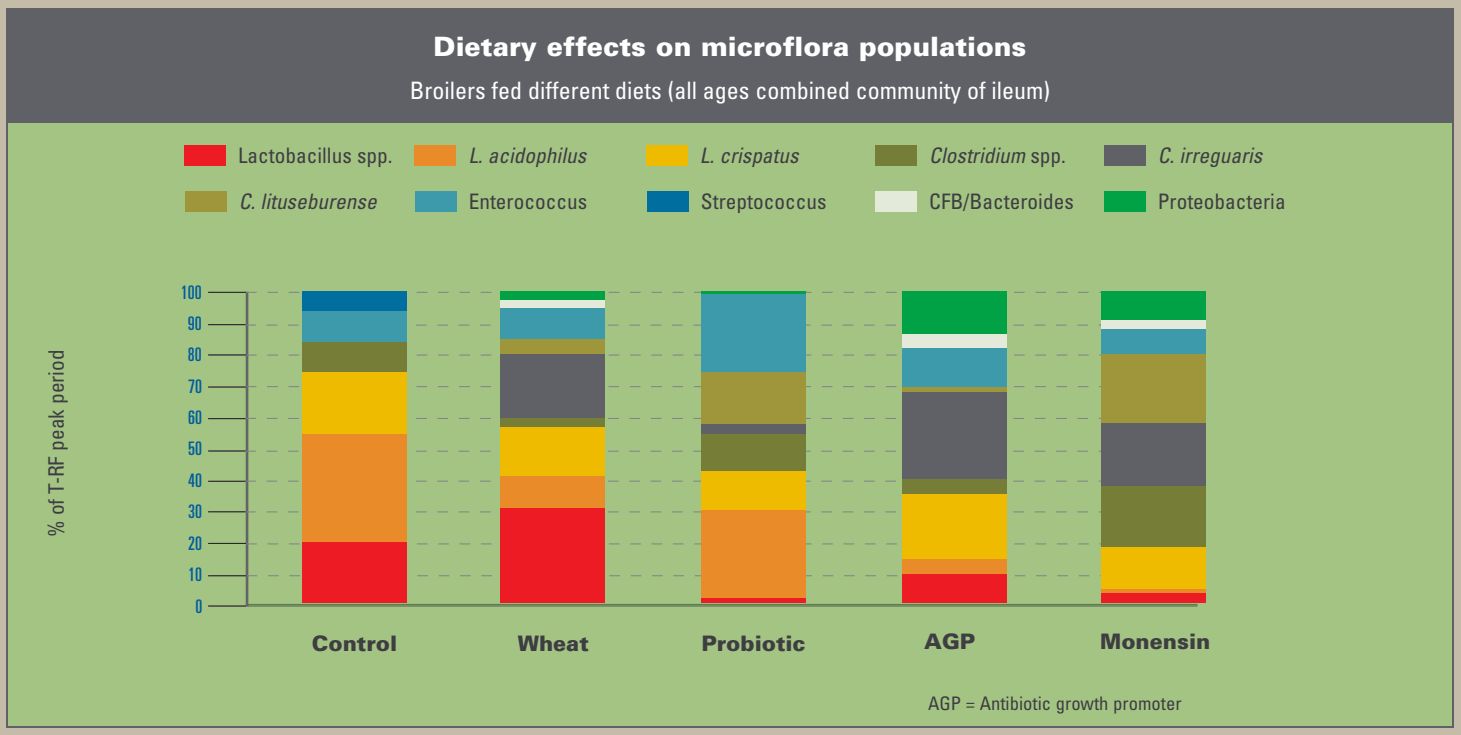


Figure 1. Different types of diets can produce markedly different populations of microflora in the gut of a chicken.

Why is that important? Collett explained that proteins moving through the gut quickly have less time to be digested. The result is that relatively large protein molecules arrive in the cecum and can stimulate an immune response, which in turn can cause inflammation.

When birds have an inflammatory response in the cecum, they shunt food back into the small intestine — a process that creates a potentially dangerous situation. "We know that clostridial organisms in the small intestine, once they get access to nutrients, can replicate very quickly," he said. "And in this rapid growth phase, they produce a tremendous amount of toxin. This creates perfect conditions for necrotic enteritis to develop."

Collett explained that different types of diets could produce markedly different populations of microflora in the gut of chicken (Figure 1). He emphasized that by paying attention to food quality — for example, supplying young broilers with a healthy mix of soluble and non-soluble proteins in their feed — growers can help maintain a healthy mix of intestinal flora and minimize problems with NE.

How can producers tell what's in the intestinal flora of their flocks?

Regular posting sessions can help, Collett said. "When you see ceca contents that are pasty, that means you probably have a significant number of organisms present," he said. "When the contents are more watery, that indicates fewer organisms."

continued

Collett

Collett emphasized that the initial colonization of the chick's gut begins the moment it's placed on the floor of the house, where it's immediately challenged with an enormous number of organisms. "Those organisms are derived from the previous cycle's gut flora," he explained. "If we change the gastrointestinal flora in our birds, it's going to change the flora in the whole house over time."

The impact of changes in house flora isn't usually easy to spot, at least immediately, Collett said.

"It's a replacement/displacement," he explained. "But these kinds of changes are very important, particularly when you're talking about removing antibiotics from your operation."

Lessons from niche-marketers

In an interview following his presentation, Collett was asked to elaborate on that last point: What sorts of practical lessons about gut health have been gained from the experience of niche marketers — growers who have several years' experience producing antibiotic-free broilers?

> I think vaccination is a very important part of the drug-free approach.

He said several lessons could be learned. First, and perhaps most importantly, these producers have demonstrated that it is, indeed, possible to produce broiler meat as efficiently without antibiotics as it is with antibiotics.

Second, he said niche marketers have learned that when growing broilers without antibiotics, they have to pay considerably more attention to maintaining healthy intestinal flora.

"In the past, we've been able to use antibiotics to suppress the population of organisms migrating back up from the cecum to the small intestine," Collett explains. "But now [without antibiotics], we have to monitor and regulate the cecal population, so that we don't get that migration up the tract."

Collett suggested that vaccination could be a useful tool for managing disease without antibiotics. "I think vaccination is a very important part of the drug-free approach," he said, "particularly during the transition phase when you're trying to move away from antibiotics and anticoccidials."

He emphasized that, unlike drugs, which may be toxic or alien to the bird's natural physiology, vaccines work by triggering a normal immune response against disease organisms.

"They're the natural way to go."

Broussard

And once you ve removed the protective effects of the subtherapeutic antibiotics, necrotic enteritis plays a bigger role.

DR. CHARLIE BROUSSARD

Broussard:

'Progeny from the vaccinated hens had 72% less chance of mortality'

The world's first vaccine for managing necrotic enteritis in broilers is designed to *combat a toxin produced by Clostridium perfringens* type A — the toxin that is associated with development of the disease. Officially known as *Clostridium perfringens* type A toxoid, the conditionally approved vaccine employs an inactivated fragment of the toxin, called a toxoid, to elicit immunity to the toxin. The hens then pass on that immunity on to their progeny.

The vaccine, developed by Schering-Plough Animal Health, got high marks in laboratory studies and in limited field trials. But how would this NE toxoid vaccine perform in real-world conditions?

To find that out, Schering-Plough put together a series of trials, vaccinating 1.5 million hens and generating data on more than 21 million of their progeny.

At the Orlando symposium, Dr. Charlie Broussard, worldwide technical service veterinarian for the company's poultry business unit, reported on trials aimed at evaluating the NE toxoid's efficacy in broilers that received no antibiotics.

Antibiotic-free birds face increased risk of NE

Broussard noted that this arm of the study was especially important because more and more broiler producers are bending to consumer and regulatory pressures by pulling antibiotics and growth promoters from their birds' rations.

"And once you've removed the protective effects of the subtherapeutic antibiotics, necrotic enteritis plays a bigger role," he said.

Broussard also stressed that while producers are well aware of how many birds NE can kill, they tend to be less familiar with the devastating effects

Broussard

that subclinical disease can have on the performance of their flocks. In one recent survey, U.S. veterinarians who were polled said they believe losses from subclinical NE may total as much as 5 cents per bird. "So there's a lot of performance loss going on in addition to what most people think of as necrotic enteritis — dead birds," Broussard said.

The company chosen for the site of the antibiotic-free trial had a history of NE, especially during cold and rainy weather. The trial began in February 2005; about 80,000 pullets were vaccinated via intramuscular injection and were given a booster vaccination 8 weeks later.

The vaccinated pullets were then shipped to 7 breeder farms. "The pullets were vaccinated over time," Broussard explained, "so we had breeder ages all the way from young to the old in the trial." Eggs were collected 4 times each day at the farms and the chicks hatched.

Before he discussed the results of the trial on the progeny from the vaccinated hens, Broussard emphasized an important point. He said that for evaluation purposes, progeny flocks in the trials were divided into only two categories:

1. **Flocks in which *all* the birds came from vaccinated hens**
2. **Flocks in which less than all the birds came from vaccinated hens**

Broussard emphasized an important point. In some cases, he pointed out, the flocks categorized as nonvaccinated progeny contained a sizable number of birds whose hen parent had been vaccinated. In total, the trial included about 1.3 million birds in the all-vaccinated group and about 4.6 million in the standard group. Bird size of the progeny ranged from about 4.5 to 5 pounds (2.04 to 2.27 kg).

One other caveat: During the trial, when any flock exhibited NE-related mortality at a rate of 4 birds per 1,000 or higher, they were treated with the antibiotic sulfadimathoxine. "So you need to factor in that any time mortality really started going out of whack for these birds in the standard category, they were getting some treatment for necrotic enteritis," Broussard explained.

As to results of the trial, Broussard first compared the performance of all-vaccinated progeny versus standard birds early in the trial, at days 8 to 14 (Figure 1).

"Even at this point, we were already seeing a difference of approximately a 0.25% in mortality — 0.63% for the all-vaccinated progeny and 0.88% for the standard birds," he said.

During the next evaluation period, 15-21 days, when mortality tends to be on the rise, mortality rates were .89% for the all-vaccinated progeny and 1.27% for the controls (Figure 2).

Historically, for companies raising broilers, the next period of growth — days 22-28 — would be a high-mortality time for NE, and that was indeed the case for the company that hosted the trial. Even during this difficult time, however, vaccinated progeny continued to do well, with 47% reduced mortality, .98% versus 1.45% in standard birds, Brossard said (Figure 3).

What particularly caught the eye of the host company, Broussard said, was when the researchers carrying out the study

Figure 1.
At 8 to 14 days, mortality for all-vaccinated progeny was 0.63%, compared to 0.88% for standard birds.

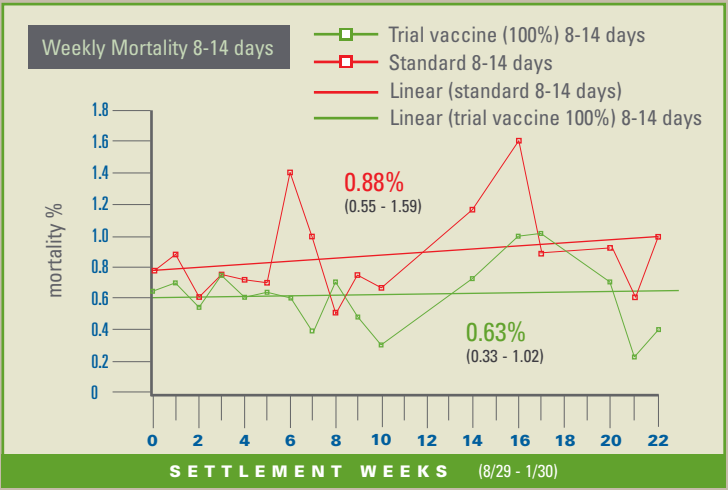


Figure 2.
At 15 to 21 days, mortality for all-vaccinated progeny was 0.89%, compared to 1.27% for standard birds.

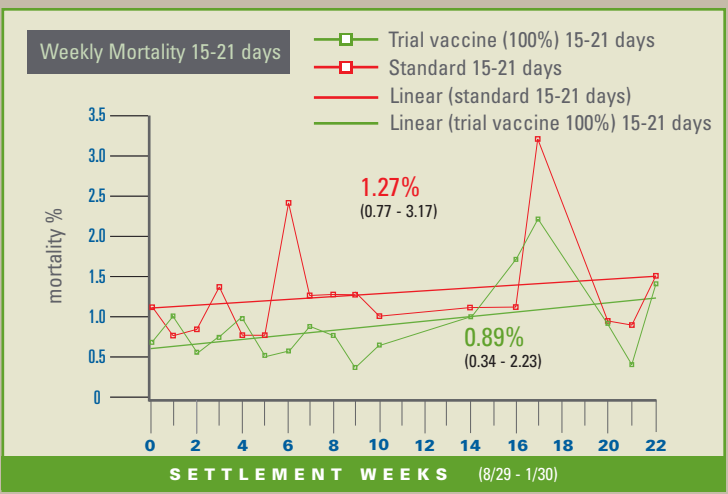
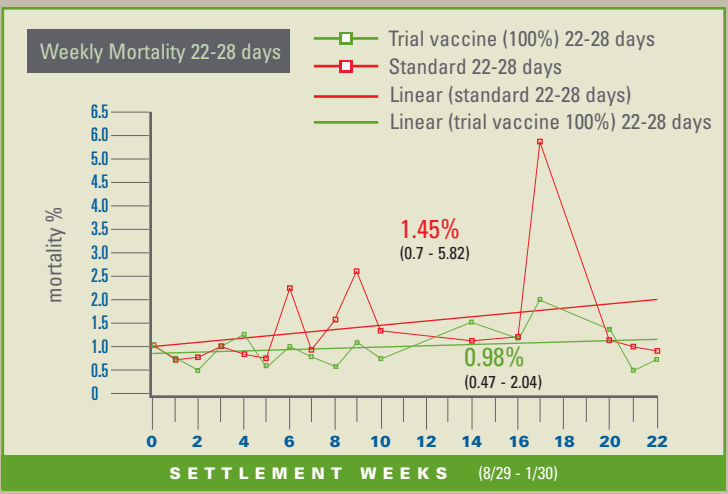


Figure 3.
At 22 to 28 days, mortality for all-vaccinated progeny was 0.98%, compared to 1.45% for standard birds.



broke out mortality data for only the colder, wetter months.

"When we looked at only that particular time, when the company had told us that they — like a lot of companies — had experienced their main NE challenge, we found that progeny from the vaccinated hens had 72% less chance of mortality than progeny in the standard group," Broussard said, adding that the difference takes into account that some of the birds in the standard group had come from vaccinated hens.

Broussard said the host company was impressed by the results of the trials. "So much so that they recently decided to vaccinate all their breeder flocks with the NE toxoid," he reported.

Editor's note: The poultry company involved with the NE toxoid trial agreed to share this data on the condition that the company's name and location not be reported.

Alfonso

We think growers who protect their birds against clostridium may see other improvements too.

DR. MATILDE ALFONSO

Alfonso:

'We showed improvements in livability and feed conversion'

Although some broiler producers are backing off ionophore antibiotics for controlling coccidiosis in broilers, a good number still rely heavily on the use of those agents — at least for now.

To find out how its new *Clostridium perfringens* type A toxoid would control necrotic enteritis (NE) in these types of operations, Schering-Plough Animal Health conducted a huge trial involving nearly 22 million broilers.

Dr. Matilde Alfonso, a technical services veterinarian for the company who was involved with the trial, explained that the design of the study was straightforward — compare the progeny of vaccinated hens with those of non-vaccinated hens. Developing such a pure comparison in real-world field conditions created some challenges, however.

"Most growers stock their barns with birds from different breeder sources, so that made it tough to find a 100% vaccinated flock," she explained.

That being the case, researchers decided that flocks with 70% or more of birds vaccinated would be evaluated as part of the vaccinated group. Flocks with less than 70% vaccinated birds served as controls.

In all, more than 750,000 hens were vaccinated. Vaccinated birds received a 0.5-ml subcutaneous injection of the NE toxoid at 10 weeks of age and a booster at 18 weeks. Researchers then followed 22 million of their progeny, along with controls, over a 6-month period.

All birds were fed a standard corn-soybean mix, with an in-feed ionophore. "No antibiotic growth promoters were used," Alfonso said, "and that's a key point" of the study because those compounds help to control necrotic enteritis.

There was considerable variation in the size of the birds included in the trial, ranging from 4 to 6 pounds (1.81 to 2.72 kg). There was variation, too, in the respective locations of the four farms that took part in

Results of combined complexes (8/8 with favorable results)

	All complexes (n=193 Netvax locks)	Difference Netvax vs. Control
Livability (%)	+	+0.42
Condemnations (%)	n.s.	0.00
Feed conversion	+	-0.0091
Average weight (lbs)	+	+0.01
Average daily gain (lbs/day)	+	+0.0001
Calorie conversion	+	-13
Adjusted caloric conversion	+	-15
Standard cost ($/lb live weight)	+	-0.001

Figure 1. Trials showed an improvement in livability of 0.42% with significant reductions in feed conversion. Calorie conversion and adjusted calorie conversion also improved, as did standard cost.

the study, with operations scattered across a wide geographic and climatic range.

Moving on to results of the trial, Alfonso emphasized that incidence of necrotic enteritis on these farms was historically low, seen in only 0.07% to 1.1% of flocks each month.

"The anticoccidials were keeping the lid on necrotic enteritis," she said. "The incidence was very sporadic."

So how did the progeny of the NE-toxoid vaccinated birds compare with progeny of non-vaccinated birds?

"We saw positive trends for the NE toxoid in each of the individual study complexes," Alfonso reported, adding that some trends for individual complexes, when evaluated individually, did not reach statistical significance.

That changed, however, when the data for the study sites were combined (Figure 1). Alfonso said that by pooling the results and thereby increasing the sample size, some of the differences in the two groups became statistically significant.

"We showed an improvement in livability of 0.42%. We also got a significant reduction in feed conversion," she said of the progeny from the vaccinated hens. "Both calorie conversion and adjusted calorie conversion improved, -13 and -15, respectively, as did standard cost, which went down by 0.001 dollar per pound of live weight."

Average weight and rates of daily gain also showed an increase, though those improvements were not statistically significant. "But the trend was positive, and that's what counts," she said.

Alfonso noted that overall, the progeny of NE-toxoid vaccinated hens showed better performance. "And we think that may be due to the vaccine controlling subclinical necrotic enteritis, which in turn may help reduce other health problems that tend to be associated with NE."

She added that she thinks growers who are seeing poor performance in their flocks might benefit from using the new NE toxoid.

"And we're not just talking about mortality here," she emphasized. "We think growers who protect their birds against clostridium may see other improvements too."

In cattle and sheep, we ve seen GD lesions develop from damage to the intestinal mucosa, so we re starting to take a closer look at that in poultry.

DR. STEPHEN COLLETT

Collett:

'We've seen GD lesions develop from damage to intestinal mucosa'

In recent years, poultry growers have been seeing an increase in the incidence of gangrenous dermatitis (GD) — a subcutaneous infection in poultry that may be caused by clostridial bacteria of various species.

It's become a major health problem among broiler flocks in the United States, resulting in high mortality, carcass condemnations and trimmed parts. Economic losses have been estimated to be as much as $1.31 per affected bird.

Poultry researchers are not yet sure why gangrenous dermatitis is on the rise, but they are making headway in understanding this complex disease. One of the insights they have gained recently points increasingly to a possible link between GD and intestinal health.

Dr. Stephen Collett, professor of veterinary medicine at the University of Georgia, delivered a presentation on gangrenous dermatitis at the Orlando meeting and highlighted what has been learned about this intriguing disease.

GD requires portal of entry

Collett began his talk by explaining that three primary etiologic agents are responsible for breaks of gangrenous dermatitis: *Clostridium perfringens, Clostridium septicum* and *Staphylococcus aureus*.

None of these organisms, he said, is adept at infecting its host without a portal of entry. "They need a damaged area," Collett added. "Often it's damaged skin, a scratch. But in cattle and sheep, we've seen GD lesions develop from damage to the intestinal mucosa, so we're starting to take a closer look at that in poultry."

Immune suppression also plays a key role in setting up the host for infection. Infectious bursal disease (IBD), chick anemia virus (CAV) and other common poultry problems all can take a heavy toll on bird immunity and make conditions ripe for a GD break.

Environmental stressors also come into play. Extremes in temperature can, of course, sap bird immunity. In addition, such extremes — especially the combination of high heat and moisture — can foster conditions that make it easy for GD's causative organisms to grow and thrive in broiler houses. It is not surprising, then, that GD has the tendency to be a recurring problem on farms where favorable environmental conditions exist, Collett said.

GD has an incubation period of 3 to 5 weeks and the course of the disease is 10 days to 2 weeks. Collett emphasized that one of the unfortunate characteristics of GD is that it tends to be a late-stage illness, with the disease often appearing in birds after considerable resources have already been spent growing them.

Few clinical signs of gangrenous dermatitis are observed in the field. "We find dead birds; we don't see many clinical signs," Collett said. "But one sign of GD you do see in the field are blue-wing lesions. That occurs especially in young chicks that have been infected vertically with CAV. Their immune systems are very compromised and they develop those typical kinds of lesions."

So-called 'blue wing' lesions are common in immunocompromised chicks that have been vertically infected with chick anemia virus. (Photos courtesy of Dr. Collett.)

Postmortem examinations of birds with GD exhibit massive hemorrhaging under the skin, along the back, the thigh and the hips. GD-causing organisms characteristically are gas forming, so an accumulation of gas is often seen in the liver and sometimes in other anatomic structures. Postmortem studies may also show evidence of retained yolk sacs (associated with poor chick quality), anemia and pallor in the appearance of bone marrow.

Control of GD demands multifaceted effort

Collett said that treatment and prevention of GD is best coordinated on several fronts:

1. Providing good nutrition
2. Controlling moisture content in the litter (with frequent clean-outs)
3. Using vaccines to thwart immunosuppressive diseases such as IBD and CAV
4. Reducing risks of skin injury by limiting stocking density and providing adequate feed and water to reduce pecking
5. Administering antibiotics as needed

Interestingly, Collett said that experience in human medicine is helping poultry researchers better understand when to use the various types of therapeutic antibiotics.

"For example, what they find in humans is that penicillin is very effective at killing off an organism, but it's very ineffective at stopping an infection that has already begun," he said, adding that researchers think that may be because penicillin appears to have no effect on the chain of events that produce toxins in the organism.

"But if they instead treat an already-infected person with tetracycline instead

Collett

of penicillin, there's a much greater effect — not because tetracycline is more effective at killing the organism, but because it shuts off the genetic pathway for producing toxin."

Collett says that with an eye on those observations in human medicine, many poultry veterinarians are now leaning toward in-feed tetracycline as the drug of choice for treating GD breaks.

Published reports have suggested that coccidiosis vaccination may indirectly help reduce or eliminate the incidence of GD by greatly lowering the risk of coccidiosis breaks resulting from late coccidia cycling. (See *CocciForum* No. 12B at www.thepoultrysite.com/cocciforum.)

Is GD skin or gut related? Probably both

Following the presentations by Collett and Roney, the symposium's moderator, Dr. Rick Phillips of Schering-Plough Animal Health, noted that "two lines of thought have developed" about gangrenous dermatitis.

One pegs GD as a "scratch-related issue," while the other asks whether GD is coming through the gut as well," he said.

"If you look at other species — cattle and sheep, for example — clostridia play a major role, it's gut-associated. It showers the blood, settles out and then creates problems later," Phillips added.

The veterinarian thinks that vulnerability in both the skin and in the lining of the intestine probably plays a role in allowing GD to gain entry.

"One of the things we've seen in posting sessions coast to coast is that operations that have different kinds of programs for managing coccidiosis often have dramatic differences in their rates of dermatitis," he said.

What was notable in many of the operations that had lowered their rates of GD was that they had used coccidiosis vaccine to modify the window of coccidial cycling. "On their earlier programs, they were cycling about 8 days earlier than with the vaccine. And that peak cycling was occurring right at the time the dermatitis would kick in," Phillips reported. When those operations began using the vaccine, they effectively moved outside of that coccidia-cycling window and the rate of dermatitis decreased significantly.

Phillips emphasized that it is by no means clear the exact role that vaccination can play in managing dermatitis. More work needs to be done to determine how coccidiosis and gangrenous dermatitis interact with each other.

But, he added, "Doing that kind of research is a priority for us. It's very important for us in the industry to decide if the intestinal issue is associated with the development of GD. Because if it is, that demands a whole different management strategy."

Once the birds had been on the vaccine for 35 days, we had no more dermatitis.

DR. STEVE RONEY

Roney:

'We've faced challenges with gangrenous dermatitis'

Researchers are making significant strides in understanding the mechanisms behind gangrenous dermatitis in poultry. But while researchers continue experimenting in their labs and making observations at posting sessions, broiler growers are learning about GD, too – practical and sometimes tough lessons from their day-to-day operations.

At the Intestinal Health meeting in Orlando, Dr. Steve Roney, formerly director of veterinary services, eastern region, Gold Kist, Inc., and now a US-based veterinary consultant, said he has faced challenges with gangrenous dermatitis on nearly a daily basis for much of the past 7 or 8 years. "It's one of the most complicated syndromes I've ever dealt with."

Experience with larger birds

Roney first discussed some experiences he had with a complex that grew primarily large birds. The operation was having problems with GD and Roney was writing two or three penicillin prescriptions weekly.

"This is a complex that was moving 1.8 million birds a week," he added. "We were losing overall a 0.25% livability due to gangrenous dermatitis. That's 4,500 chickens per week. So that disease alone — without any of the other costs of growing the chicken — was costing us $10,000 each week."

The birds had been on a nicarbazin-ionophore shuttle program before Roney decided to switch to Coccivac-B in the early spring.

"Our last case of dermatitis was in one of the birds that was on the nicarbazin-ionophore program," he said. "Once the birds had been on the vaccine for 35 days, we had no more dermatitis."

Roney reminded the audience that the move to coccidiosis vaccine was made in April, just as the environmental challenge

Roney

from weather was easing. "So, would it have stopped anyway? I don't know. But we've seen over and over that these things happen when we move to the coccidiosis vaccine."

The veterinarian said one explanation could be that in shifting coccidia cycling to earlier in the bird's life, there is less stress on the bird later, making it less vulnerable to GD.

Antibiotics posed challenges

At one plant that produced three different sized birds, the use of antibiotics posed challenges. "We have run vaccine on the birds that are 3.90 lbs. in weight. We find that if we don't fortify the diet early with protein we lose about 3 points in feed conversion," which he thinks is a viable approach if ionophores are losing efficacy.

Generally, however, the company is steering away from 3.90-pound (1.77 kg) birds until more is learned about how to fortify their diets and maintain feed conversion when changes are made in their program. "But anything over 4.40 pounds (2 kg) is fair game right now," Roney added.

Under the present strategy, the complex utilizes a coccidiosis vaccine every year for two to three cycles; the program varies depending on the size of bird. He said the approach has worked well. "It's helped us keep our ionophores in much better shape than they would have been, in my opinion."

Another complex operated by the company had been utilizing a rotation program of ionophores for years, but Roney said that within the first cycle the houses would break with *Eimeria tenella* and with *E. maxima.* That operation produced a colored bird, and he said he and his team had initially been very reluctant to add coccidiosis vaccine to the program, thinking it might cause a loss of color in the birds.

"But it got to the point where we had no choice," he said. "A lot of things you do it's because you have no choice."

Coccivac-B was added to the program. In addition, they decided to include a three-quarter dose of roxarsone, the arsenic derivative anticoccidial, but only in the grower ration. Their reasoning was that the drug wouldn't be needed in any other ration because it was summer and the birds they were dealing with were large.

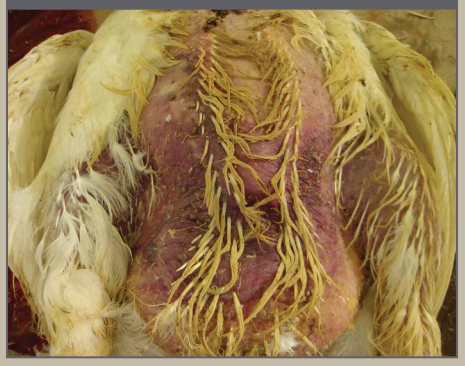
Under the present strategy, the complex utilizes a coccidiosis vaccine every year for two to three cycles; the program varies depending on the size of bird.

The results?

"Lo and behold, we lost no color — we never had a complaint about that," Roney said. "And the birds had some of the best performance they've ever had."

Roney said the complex is now using coccidiosis vaccine on a yearly basis.

Gangrenous Dermatitis



Though GD manifests primarily on the skin, many researchers are convinced intestinal factors play a role in its etiology.

Testing the coccidia-cycling theory

Roney and his colleagues then wondered what factors were *causing* these decreases in the incidence of gangrenous dermatitis. Was it an indirect benefit of using the coccidiosis vaccine? Did vaccination shift the cycling of oocysts back a few days, therefore taking away the 30-day challenge from the birds? And, if that were so, might the same results be obtained using an in-feed anticoccidial instead of the vaccine to thwart that late coccidiosis challenge?

To find out, Roney decided to take a different approach. Instead of using the vaccine to shift the coccidiosis cycle, he instead added the anticoccidial Clinacox (diclazuril). "We put it in for 7 days in the first withdrawal," he added. "Based on the posting sessions we'd had, that seemed to be where we were getting the heaviest challenge from *E. maxima*."

When the birds reached about 35 days, problems with gangrenous dermatitis subsided. Roney emphasized, however, that other factors might have played a role in the decrease of GD.

"We had made a minor change in the feed — removed some bakery byproduct," he said. It is difficult to know for certain whether the byproduct was contributing to the problem, he added, because another broiler complex — one that did not have problems with dermatitis — was also using the bakery product. He thinks the reduction in incidence of GD could have been due to a combination of factors.

So that disease alone without any of the other costs of growing the chicken was costing us $10,000 each week.

Leaving Its Mark

Poultry producers should take a second look at their control strategies for coccidiosis following reports that the parasite *Eimeria mivati* is indeed a distinct species found in about 35 percent of broiler flocks, says Steve Fitz-Coy, PhD, of Schering-Plough Animal Health technical services.

This coccidian species has been controversial among poultry pathologists. Some believe it to be a variant of *E. acervulina* or a mixture of *E. acervulina* and *E. mitis*, but careful study of *E. mivati* by Fitz-Coy, a parasitologist, indicates otherwise.

In a study with broilers, Fitz-Coy immunized one group of birds with *E. acervulina* and a second group with a strain he identified as *E. mivati*. A third group served as controls, was coccidian-free and received anticoccidials for two weeks.

The birds were then inoculated with either *E. acervulina* or *E. mivati* 3 times weekly for 3 weeks. At 28 days of age, they were randomly challenged by gavage with 500,000 sporulated oocysts of either *E. acervulina* or *E. mivati*. Unimmunized control birds were also challenged with one or the other *Eimeria* species.

Six days after challenge, the birds were evaluated for weight, gross lesions (Figure 1) and microscopic evidence of parasite burdens, says Fitz-Coy, who presented these findings last year at the Poultry Science Association annual meeting.

Pathogenicity

Birds challenged with the same species they were immunized with had protection, but birds challenged with the other species — a heterologous species — had no protection, Fitz-Coy says.

"*E. mivati* was more pathogenic than *E. acervulina* because it caused greater growth suppression, more gross lesions (see Figure 1) and more microscopic parasitism than *E. acervulina*. In addition, the only mortality — 18% — occurred in the controls that were challenged with *E. mivati* (Table 1), says Fitz-Coy. He notes that it has been reported that *E. acervulina* seldom causes death and that he has never conducted a challenge study with *E. acervulina* that resulted in deaths.

Leaving Its Mark

Immunized	Challenged	Wt (gm)	Gross lesions	Micro score	% Mortality
Control	*E. acervulina*	278^{c}	4.3^{ab}	6.33^{b}	0^{b}
Control	***E. mivati***	**91^{d}**	**5.6^{a}**	**10.73^{a}**	**18^{a}**
E. acervulina	*E. acervulina*	389^{ab}	0^{d}	0.17^{c}	0^{b}
E. acervulina	*E. mivati*	264^{c}	2.42^{bc}	10.5^{a}	0^{b}
E. mivati	*E. acervulina*	313^{bc}	1.42^{cd}	5.5^{b}	0^{b}
E. mivati	*E. mivati*	420^{a}	0.17^{d}	0.4^{c}	0^{b}

Table 1. Comparisons of immunization and challenge measured by weight, gross lesions, microscopic parasite burden and mortality.
Data in a column with different superscript are different (P<0.05).

Birds immunized with *E. acervulina* and then challenged with *E. mivati* did not experience mortality, but had decreased weight and a moderately severe level of parasitism, he says.

In additional studies conducted by Fitz-Coy using coccidia-naïve chickens inoculated with semi-purified inocula, *E. mivati* produced mortality that ranged from 20% to 50%.

Fitz-Coy has also sent samples of *E. mivati* for independent polymerase chain reaction (PCR) testing, which was set up to find well-known pathogenic species of *Eimeria* such as *E. acervulina*, but not *E. mivati*. The test yielded negative results — it couldn't identify the specimens he sent, further indicating that *E. mivati* is a distinct species, the researcher notes.

Incidence

When *E. mivati* was first identified by Dr. S. Allen Edgar in 1959 during a persistent coccidiosis outbreak on poultry farms in Florida, Edgar reported that the incidence was as high as 50%.

Since 2003 to present, Fitz-Coy has conducted necropsy sessions and tested litter samples from chicken houses in numerous states, looking for *E. mivati* oocysts as Edgar first described them: smaller than *E. acervulina* and broadly oval (Figure 2). Based on this work, he

Figure 1. Gut lesions caused by *E. mivati*.

> "*E. mivati* oocysts appear to be in great abundance and are found many times throughout the entire small intestine."
>
> DR. STEVE FITZ-COY

Figure 2. An *E. mivati* oocyst is at the end of the arrow, slightly to the right. *E. mivati* oocysts are broadly oval and slightly smaller than *E. acervulina* oocysts.

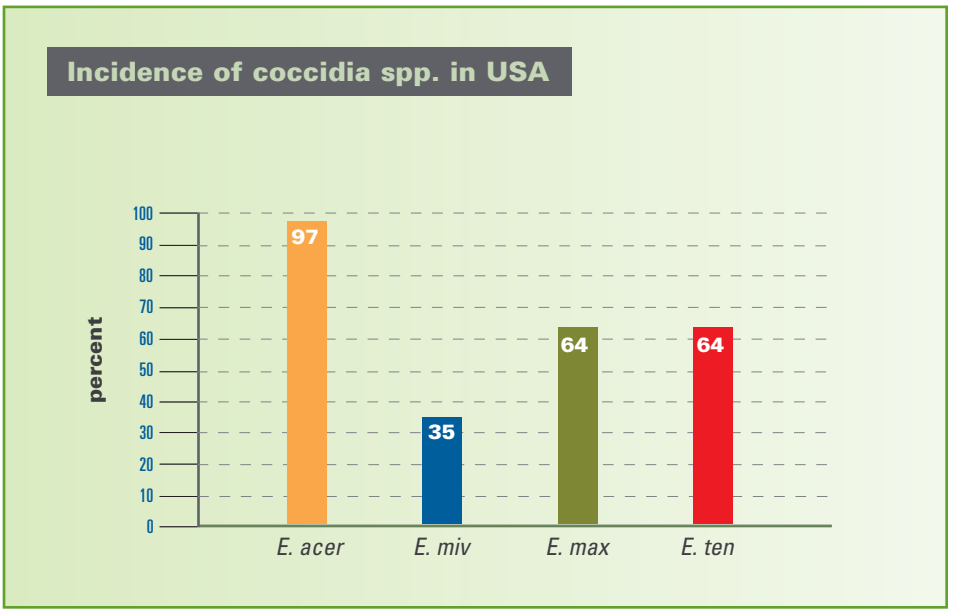


Figure 3. Studies to date indicate that *E. mivati* in the United States is lower in incidence than *E. acervulina*, but more pathogenic.

estimates the incidence of *E. mivati* to be around 35%; that's a lower incidence compared to *E. acervulina*, but *E. mivati* appears to be more pathogenic and can still cause losses for producers, Fitz-Coy says (Figure 3).

So far, Fitz-Coy has found *E. mivati* in poultry house samples from Georgia, South Carolina, North Carolina, Virginia, Delaware, Maryland, Missouri, Louisiana, Pennsylvania, California, Texas and Arkansas. There are several poultry-producing states that he's not yet obtained samples from, such as Kentucky and Ohio.

"*E. mivati* oocysts appear to be in great abundance and are found many times throughout the entire small intestine. *E. mivati* is present in poultry houses, it is not *E. acervulina*, it is pathogenic, prevalent — and it can kill chickens," Fitz-Coy says.

worth repeating

Perhaps, the most important management practice involved in the control of necrotic enteritis is the regular collection and disposal of the dead. If the dead are not frequently collected... cannibalism will occur, exposing other birds to large number of *Clostridium perfringens*, spreading the disease.

AVIAN ADVICE
UNIVERSITY OF ARKANSAS
SUMMER 2007

My concern is that producers are getting used to the problem. They don t see coccidiosis for what it really is a costly disease that can have a big impact on their operation, often without them knowing it.

DR. WIL LANDMAN
ANIMAL HEALTH SERVICE, LTD.
THE NETHERLANDS

Chicken is the most widely available organic meat... Organic chicken dominates because of the relatively short production cycle, low price premium and integrated production.

AGRICULTURAL MARKETING RESOURCE CENTER
MAY 2007

COCCIFORUM'S INTESTINAL health
NORTH AMERICA

Executive Editors: **Stephen P. Collins, Marcelo Lang**
Technical Advisor: **Charlie Broussard, DVM**
Managing Editor: **Joseph Feeks**
Associate Editor: **Diana Delmar**
Field Editor: **Steven Fox**
Design and Production: **Susanna Ronner**
Proofreader: **Sara Crafts**

Intestinal Health (formerly ***CocciForum***) is published by the Worldwide Poultry Business Unit of Schering-Plough Animal Health Corporation, Summit, New Jersey, USA. The editors welcome your ideas and suggestions for news stories. Please send correspondence to ***Intestinal Health***, P.O. Box 9000, PMB 239, Edgartown, MA 02539-9000, USA. E fax: 928.569.2491, Email: jfeeks@prworks.net.
Back issues are available at www.ThePoultrySite.com/Intestinal Health