

NEW STRATEGIES FOR

ENHANCING POULTRY VALUE

AND PERFORMANCE

# I N T E S T I N A L health



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### STOPPING SUBCLINICAL COCCIDIOSIS

**W**hat harm is a little coccidiosis that appears late in a broiler's life cycle? Apparently a lot, according to studies by a poultry nutritionist at Oklahoma State University, USA, who's presented his work recently in Europe and at other international poultry conferences.



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(on the cover)

**M**ore and more mainstream poultry companies worldwide are choosing to vaccinate — not medicate — their broilers for coccidiosis. The live vaccine is sprayed onto chicks in the hatchery to stimulate early immunity and ensure lifelong protection, without coccidiosis leakage associated with worn-out in-feed anticoccidials. For Europe's latest success story with coccidiosis vaccination, see page 7. *Spray vaccination photo by Lisa Helfert.*

# E U R O P E

I H - M A G A Z I N E . C O M

# opinion: “Real-world results”

**Virtually anyone reading this magazine appreciates the importance of good research. In some cases, however, it's easy to view research results with some skepticism. After all, we all know that what appears to be promising in the laboratory might work a little differently when tested in the field.**

It's therefore gratifying for us to report on intestinal health research that's already paying dividends in the real world. Specifically, I am referring to work conducted by Dr. Robert Teeter, a nutritionist at Oklahoma State University, USA.

Teeter has spent vast amounts of time testing and studying the physical and economic impact of coccidiosis on broilers. In his latest trials, he found that when subclinical coccidiosis occurred late into the production cycle, broilers used more energy and needed more feed. There was also increased malabsorption, reduced effective caloric value and an elevated maintenance cost.

Subclinical coccidiosis late into the production cycle often occurs when in-feed anticoccidials lose effectiveness, thereby causing coccidial oocysts to leak into the flock. In fact, according to Teeter, birds near market age with even minor coccidial lesion scores — which are typical

of subclinical coccidiosis — have an average daily gain of about zero.

In contrast, the nutritionist discovered that a coccidiosis challenge that occurs early in the production cycle has a relatively minor negative effect on flock health, efficiency and profitability. An early challenge occurs when coccidiosis vaccine is administered in the hatchery or when chicks are turned out to the house, thus enabling broilers to develop lifelong immunity against coccidiosis at a young age.

**“Now we are pleased to report on a field trial conducted at a Canada broiler farm, which demonstrates that Teeter's laborious laboratory research is on the mark.”**

Marc Coulier

Now we are pleased to report on a field trial conducted at a Canada broiler farm, which demonstrates that Teeter's laborious laboratory research is on the mark.

The results of the trial, presented at a meeting by Dr. Linnea Newman — a consulting technical service veterinarian for Intervet/Schering-Plough Animal Health — show that broilers on in-feed anticoccidials had high coccidial-oocyst counts during the later part of the production cycle. And more importantly, their weight gain was zero. The producer switched to using a live-oocyst coccidiosis vaccine for a few cycles, which seeded

poultry houses with oocysts that are still highly sensitive to anticoccidials.

By the third cycle of vaccination, oocyst cycling was earlier, oocyst counts were lower and weight had improved 240 grams, compared to the first flock on anticoccidials.

When the producer returned to using anticoccidials — after the three cycles of coccidiosis vaccination — the results were excellent, thanks to the use of the vaccine.

You can get the details on Teeter's latest findings and the field trial that supports his work in our special report beginning on page 16.

## Marc Coulier

Global Marketing Director  
Intervet/Schering-Plough Animal Health  
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*P.S. We just received word that Paracox-8, our coccidiosis vaccine for broiler breeders and layers, is now used in 70% of that market segment in Australia. The Australian government is understandably very protective of its borders, so it is very difficult to introduce new live vaccines to that market. Since its approval there in 2008, Paracox-8 has proved to be a huge exception to the rule — not to mention a valuable asset to the Australian poultry industry. Special thanks to the many veterinarians and opinion leaders who saw the product's potential and helped to make this possible.*



## Foz do Iguaçu



**Foz do Iguaçu, Brazil, was the site of an annual intestinal health conference sponsored by Intervet/Schering-Plough Animal Health.**

**P**oultry producers stand to reap major rewards despite the challenges they face in coming years, predicted Osler Desouzart, an international consultant on meat production.

Desouzart pointed out that poultry's popularity as an animal source of protein has grown phenomenally. Since the mid-1900s, the accumulated growth in poultry production has been a staggering 2,049% — three times faster than the growth rate for pork and 8.7 times faster than beef, he said.

As the demand for poultry has increased, so has the industry's success in finding ways to grow birds more quickly and more efficiently, a success that Desouzart describes as remarkable. "We've made more progress in the past 10 years than our forbearers did in the previous 10,000," he said.

Consumer values have also changed; consumers are more interested in how products differ from one another in quality and wholesomeness, he said.

### Tips for future success

For success in the future, Desouzart advised poultry producers to focus on quality, creating value in their products, and on generating facts and data and making them available to consumers.

"You also need to be open to doing things in new ways and taking advantage of the latest developments in science and technology, including medications and vaccines," he said. "The integrators who are the most successful will be those that embrace change rather than resist it."

Also important for success will be fostering cooperation with competitors to push the growth of the poultry industry as a whole. "You'll find the most success if you hunt as a group," Desouzart said.



# innovation*s*

New ideas, trends, products and technologies

## ! Intestinal Health Center website offers rich content, dynamic features

Looking for the latest information on managing intestinal health in poultry?

Check out the Intestinal Health Center for Poultry ([ihc-poultry.com](http://ihc-poultry.com)) — a virtual treasure chest of online information assembled by the editors of *Intestinal Health* magazine and Intervet/Schering-Plough Animal Health.

Over the years, Intervet/Schering-Plough Animal Health has presented and published a wealth of practical, science-driven information and ideas to help producers manage costly gut diseases more effectively through vaccination, nutrition, sanitation and prudent drug use.

“The new website lets you find virtually anything you need, quickly and easily, on specific intestinal health topics and products,” says Marcelo Lang, global marketing director for the company’s Poultry Business Unit. “The recent addition of Google Translate also allows visitors to get an approximate translation of the content in virtually any language.”

The website is driven by a vigorous content-management system that automatically searches the library and creates new drop-down menus every time users select a topic or product. For example, clicking on “Necrotic Enteritis” brings users to a page describing the

The screenshot shows the website interface for the Intestinal Health Center for Poultry. The main article is titled "Necrotic enteritis" and includes a detailed description of the disease, its symptoms, and treatment options. A green navigation bar at the top lists various categories like News, Topics, Interventions, Products, Links, About IHC, My library, and Get newsletters. A sidebar on the left offers options to add the article to a library, view related articles, or print it. The article text discusses the subclinical form of necrotic enteritis and the impact of antibiotic resistance on its treatment.

disease and a menu of 38 articles, six technical papers, one brochure, seven slide presentations and six podcasts, as well as 17 items produced in Spanish.

Once users find information that interests them, they can read the document online or click on icons to print or email it. They can also create their own library of “favorites” and sign up to be informed about new information on specific topics.

The website also offers a library of past issues of the company’s *Intestinal Health* magazine and its predecessor, *CocciForum*,

as well as three newsletters — *Broiler Health*, *Layer Health* and *Turkey Health*. Just click on “News” in the red menu bar for a complete list of publications.

In addition, the website includes an interactive feature called “Gut Reactions,” where visitors can answer a frequently updated survey question related to intestinal health, immediately view survey results and then access links with more information on that topic. There is also a handy product finder to help users locate Intervet/Schering-Plough Animal Health intestinal health products available in their market.

“The Intestinal Health Center for Poultry is another example of Intervet/Schering-Plough Animal Health’s commitment to educating the industry about this increasingly important segment of poultry health,” Lang says. “We look forward to getting feedback on the site so that we can make it even better.”

*When an article or subject page is displayed online, Intestinal Health magazine’s website automatically creates a menu (green bar) showing additional resources for more information. In this example, the website found 38 news articles related to necrotic enteritis, plus six technical articles, seven slide presentations and six podcasts, as well as 17 items produced in Spanish.*



# research watch

## Vaccination more effective than anticoccidial drugs for coccidiosis

Vaccination is a more effective way to control coccidiosis than drugs and may become less expensive in the future by making use of cross-protection between some *Eimeria* species, Herman Peek, of the University of Utrecht, says in his doctoral thesis.

Peek demonstrated that on Dutch, German and Spanish poultry farms, the *Eimeria* parasites that cause coccidiosis are often resistant to anticoccidial drugs.

In contrast, vaccination has proved to be a very effective strategy against coccidiosis; in addition, there is an association between vaccinating with parasites sensitive to anticoccidials and a reduction in the number of resistant parasites on farms, Peek says in his thesis, entitled "Resistance to anticoccidial drugs: alternative strategies to control coccidiosis in broilers."

Investigation of ibuprofen, protease and a prebiotic as coccidiosis-control methods indicated they have limited anticoccidial effects and cannot be considered effective alternatives to current treatments, Peek says in his thesis, according to a report on [thepoultrysite.com](http://thepoultrysite.com).

He believes that it may eventually be possible to produce coccidiosis vaccines that are less expensive and more effective if further research can demonstrate cross-protection among *Eimeria* species, enabling fewer species to be included in coccidiosis vaccines or the dosage to be reduced. Broilers vaccinated at 1 day of age with an *E. acervulina* vaccine line had complete protection against a challenge with *E. acervulina* but also partial cross-protection against *E. tenella*; there was no protection against *E. maxima*, however, he says.

Peek points out that coccidiosis remains common, resulting in significant economic losses due to reduced feed-conversion efficiency, slower growth, increased mortality and expenditures for prevention and treatment.

## 'Bio-antibiotic' growth promoters developed by Italian researchers

Using green algae, Italian scientists say they've developed a new strain of antibiotics that can be used as a growth promoter without the detrimental effects of products that are currently banned in some countries.

"We have discovered a green algae type that only grows in certain bays along the Italian coast that form the basis for a micro bio-chemical factory," says Philippa so Molto, of the Italian Istituto di Ricerche Scioccheze, Milan.

The investigator and his colleague, Dr. Antonio di Sapientone, inserted genes for production of several different therapeutic proteins that are currently made in yeast, bacteria and mammalian cells.

The resulting "bio-antibiotics" considerably improved feed conversion in broilers, and they do not induce resistance or end up in manure and the environment because they are completely broken down during digestion, according to a report on [WouldPoultry.net](http://WouldPoultry.net).

In addition, the production system for the bio-antibiotics does not require expensive laboratory and fermentation equipment, since algae grow abundantly in the saline waters of the Mediterranean Sea and subsist on sunlight and carbon dioxide in the air, the investigators say.

The researchers don't elaborate on the active ingredients or their manufacturing procedures because they have filed for registration and a patent.

Coccidiosis  
vaccination  
is put to  
the test

### Coccidiosis Vaccine Test

- Reduces/eliminates drugs**
- No residue worries in feed mill**
- No coccidia leakage**
- Lifelong protection**
- Better feed conversion/gains**



It was in 2007 when Alain Coeudevez, manager of the Ets Michel “Certi’ Ferme” poultry line, decided to investigate the possibility of vaccinating broilers against coccidiosis.



*Alain Coeudevez (left) with Juliene Flori of Chêne-Vert Conseil and Patrice Chotard and Alain Riggi of Intervet/Schering-Plough Animal Health.*

Vaccination, he thought, might be a good fit with the poultry company’s plan to decrease its use of antibiotics, including in-feed anticoccidials.

The growing emphasis on food safety and new regulations aimed at preventing cross-contamination of poultry feed with unintended drugs underscored the importance of exploring new disease-management strategies. Ets Michel’s general manager, Ludovic Michel, also felt the new regulations were making anticoccidials too complicated to manage at the feed mill.

In addition, Ets Michel was concerned about subclinical coccidiosis, which quietly erodes performance and profits. “Visually, we saw nothing — only some abnormal droppings and a bit higher feed-conversion ratio,” Coeudevez says.

#### VACCINE TRIALS

Ets Michel, headquartered in St Germain En Cogle, France, annually processes 3 million Certi’ Ferme broilers — birds with an enhanced quality certification intended to set them apart from competitors — as well as 20 million standard broilers. Switching from in-feed anticoccidials to vaccination would, therefore, be a big change. However, Coeudevez first wanted evidence that it would work and decided a trial was in order.

During the last half of 2008, Ets Michel initiated the use of Paracox-5, a live, attenuated coccidiosis vaccine, in all of the company’s 65 certified broiler flocks, amounting to 1.4 million birds. Three flocks per house were spray-vaccinated at the hatchery on day 1 of age.

*continued*



*The results were  
impressive enough  
that all certified broilers  
are now spray-vaccinated  
against coccidiosis at  
the hatcheries.*

“We tried the vaccine for 6 months during two seasons and in several consecutive flocks to relieve any possible doubts we had about the vaccine’s efficacy,” Coeudevez says.

Jean-Luc Dupont, then with Intervet/Schering-Plough Animal Health, the manufacturer of Paracox-5, managed the trial. This included teaching Ets Michel’s staff how to properly manage vaccinated flocks and take litter samples, which were sent to the Bio Chêne Vert laboratory, where oocyst-per-gram counts were done. Samples were sent at 7, 14, 21, 28, 35 and 42 days after each vaccination cycle.

#### BETTER FCR, MORE UNIFORMITY

The results were good, with improvement in all vaccinated flocks, Coeudevez says. “We saw a real decrease in coccidial pressure on farms, with a better feed-conversion ratio (FCR) and more homogenous flocks,” even on farms with high coccidial pressure (see Table 1).

Improved uniformity was especially advantageous because most of the certified broilers are sold as a group at a fixed weight, he notes.

The trial results were convincing, Coeudevez continues. In certified broilers, there were no other deviations in

Coccidiosis  
vaccination  
is put to  
the test

Table 1. Impact of vaccination with Paracox-5 on FCR and weight

	2008		2009	
	100% of flocks	Top-performing 66% of flocks	100% of flocks	Top-performing 66% of flocks
FCR	2.23	2.22	2.18	2.19
Weight (kg)	2.222	2.225	2.232	2.221

management besides vaccination, nor did the feed formulas, the type of birds or farmers change, so the improvement in FCR can't be attributed to anything else.

The results were impressive enough that all certified broilers are now spray-vaccinated against coccidiosis at the hatcheries, and Ets Michel is reaping the benefits of having flocks without subclinical coccidiosis, he says.

The company now plans to expand coccidiosis vaccination to its standard broiler operation at the end of 2010.

#### STIMULATES EARLY IMMUNITY

**Dr. Alain Riggi**, a technical service veterinarian with Intervet/Schering-Plough Animal Health, says that about 80% of coccidiosis cases are subclinical. Dr. Juliene Flori, of Chêne-Vert Conseil, adds that upon necropsy, birds with subclinical coccidiosis have lesion scores of only 1 or 2, but "economically, it's a very expensive disease...It's a very insidious disease."

Riggi explains that in unvaccinated flocks or in medicated birds that leak infectious coccidial oocysts when their sensitivity to anticoccidials declines, coccidial pressure tends to occur late into the production cycle. This can be costly and it can do serious damage to the FCR because it's the same time that birds eat and grow the most.

Vaccination reverses the process. Birds are exposed to and develop immunity against coccidiosis early in life and are protected against a coccidial challenge for the rest of their lives, he says.

The veterinarian cautions that it takes a few cycles of vaccination for coccidial oocysts in the vaccine to replace wild coccidial strains in the poultry house and to achieve the best results with coccidiosis vaccination, as demonstrated by the Ets Michel experience.

A cost analysis conducted by Nicolas Serin, then an agricultural student training at Intervet/Schering-Plough Animal Health, demonstrated that the cost of in-feed anticoccidials, even with additional efforts at the feed mill to prevent feed contamination and poultry meat residues, still appears less expensive than coccidiosis vaccination. However, when the impact on performance is factored in, such as the lower weight gain and higher FCR that subclinical coccidiosis causes, it is more profitable to vaccinate. Perhaps more importantly, vaccination simplifies management at the feed mill and relieves concerns about contamination and residues.

"If we take into account the technical gains enabled by vaccination, we earn money," Coeudevez says. "And, we have to consider peace of mind, which can't be calculated."

*Editor's note: This report by Emeline Viénot originally appeared in the September 2010 edition of Filières Avicoles, a magazine serving the France poultry industry. It was translated and edited*

*for Intestinal Health/Europe and appears here with permission of the publisher. We are grateful to the staff of Filières Avicoles for its help and cooperation with this submission.*

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# Beware of new reovirus infection

Poultry producers are cautioned to be on the lookout for a new form of reovirus infection that has a special affinity for the gut and leads to high mortality in young broilers as well as significant production losses in birds that survive.

The infection, which has been identified on poultry operations throughout the world, is due to a unique reovirus serotype identified in recent years. It's called enteric reovirus strain (ERS) because it is generally found in broilers with malabsorption syndrome or wet litter. Recently, ERS has also been isolated from layers with wet litter and decreased production.

"If you see signs of reovirus in flocks that have been vaccinated with traditional reovirus vaccines, suspect ERS," says Dr. Rik Koopman, a veterinarian with Intervet/Schering-Plough Animal Health, Boxmeer, the Netherlands. "In fact, think of ERS in all cases of malabsorption syndrome."

Besides high mortality in affected flocks, as well as malabsorption syndrome that causes retarded growth and poor flock uniformity, ERS has been associated with lameness (tenosynovitis), viral arthritis, hepatitis and, more recently, neurological signs, he says. "ERS is very costly for producers because of the high mortality, poor flock performance and increased condemnation rates," he adds.

ERS was first isolated after serious disease outbreaks in the late 1990s among broiler flocks on different farms in Poland, Koopman explains. The outbreaks were surprising because, in most cases, the parent stock had been well-vaccinated for reovirus with both live and inactivated reovirus vaccines.

Affected birds had difficulty walking and exhibited signs of malabsorption, such

as slow growth and poor uniformity. Mortality was high — up to 70% in some flocks — and occurred at a young age, he says.

## Novel strain identified

Intervet/Schering-Plough Animal Health took swift action and sent samples to its diagnostic lab, where Dr. Adriaan van Loon and colleagues characterized the virus with a panel of monoclonal antibodies. They found that the Polish isolate had a distinct panel pattern when compared to other known reovirus strains described in the literature.

In addition, the scientists could not neutralize the novel strain with antibodies against well-known strains such as those

*continued*

included in inactivated commercial reovirus vaccines. Interestingly, antibodies induced by the newly discovered ERS could neutralize well-known reovirus strains, van Loon and associates reported in a published article (*The Veterinary Quarterly*, 2001; 23(3)129-33).

When the scientists challenged 1-day-old, specific-pathogen-free birds with the reovirus, mortality was 100%. Older birds that were challenged had lower mortality, demonstrating that resistance to the disease increases with age and that younger birds are more susceptible, van Loon and colleagues wrote. Table 1 shows the percentage of mortality among birds of various ages that were infected with ERS by various routes.

The scientists also found that experimental infection with ERS resulted in slower growth. Although they were able to isolate the virus from many different organs for 3 to 7 days after infection, ERS seemed to prefer the intestines and pancreas.

**Table 1. Mortality in broilers after experimental challenge with ERS**

Age	1 day	3 weeks	3 weeks	9 weeks
Route of administration	Oral	Footpad	Subcutaneous	Footpad
Mortality	100%	53%	12%	12%

*Note: Table adapted from Poultry Focus, July 2005.*

After the initial outbreak of ERS in Poland, Koopman says, scientists have used field screening to monitor the strain, which so far has also been found in other countries in Latin America, the Middle East, Southeast Asia, Africa and throughout Europe.

For example, in Belgium between August 2001 and October 2006, ERS was diagnosed on 21 of 70 farms that had submitted chicks for necropsy because they had disease problems, Peter De Herdt and colleagues of Intervet/Schering-Plough Animal Health say in a published paper (*The Flemish Veterinary Journal*, 2008; 77:171-176).

Of the 21 broiler flocks that appeared to be infected with ERS, 19 were from breeders that had been vaccinated with currently available reovirus vaccines.

ERS isolates from the Belgian flocks were consistently obtained from the liver, pancreas and/or intestinal tract. Clinical signs were similar in all affected flocks; the primary complaint was retarded growth, followed by wet litter and lameness. Increased mortality occurred in over 50% of the flocks, and of the 21 infected farms, the clinical signs had been showing up in multiple, successive rounds on 17 of the farms and for over 1 year on nine of them, the investigators write.

### Concurrent infections found

An interesting finding in Belgium was the presence of concurrent infections with other pathogens in 10 of the 21 ERS-infected flocks. These infections included the bacterium *Escherichia coli* and fowl adenoviruses, which manifested primarily as bacterial polyserositis and septicemia.

“This may indicate that the increased mortality in ERS infections under field conditions is especially important in flocks that at the same time are suffering from concurrent infections,” De Herdt and colleagues reported in their article. Furthermore, most of the Belgian flocks with ERS came from parent stock vaccinated against reovirus, which indicates that current reovirus vaccines cannot sufficiently protect against ERS.

Koopman says that ERS may be involved in cases of malabsorption syndrome that occur in US flocks, a possibility that is under investigation at the University of Georgia, Athens.

“It’s quite possible that ERS is present in many more countries around the world, but it’s easy to miss the diagnosis if you don’t have the proper test reagents,” he says.

To establish the diagnosis of ERS, laboratory testing must be conducted and should focus on intestinal samples. At one time, Intervet/Schering-Plough Animal Health had the only lab that could confirm ERS, since it conducted the initial research on this viral serotype, but today there are many laboratories that can confirm the presence of ERS or “ERS-like viruses,” Koopman says.

### ERS vaccine development

To prevent ERS infection and its costly consequences, Intervet/Schering-Plough Animal Health patented this unique reovirus strain and with it developed an inactivated oil-emulsion vaccine called Nobilis Reo ERS.

*continued*

“It’s quite possible that ERS is present in many more countries around the world, but it’s easy to miss the diagnosis if you don’t have the proper test reagents.”

DR. RIK KOOPMAN

Testing results with the vaccine, which were presented in 2005 at the World Veterinary Poultry Congress, Istanbul, by Dr. Saskia Van de Zande of Intervet/Schering-Plough Animal Health, indicated that “Progeny from vaccinated breeders were protected against ERS challenge.” There was no mortality and the weight decrease was significantly lower compared to chicks that came from unvaccinated breeders challenged with ERS.

Birds from vaccinated parents also had no signs of central nervous system problems, such as tremor, which Van de Zande and an associate have linked to ERS (*Veterinary Microbiology*, 2007; 120, Issues 1-2:42-49).

Nobilis Reo ERS is administered to breeders, which pass along immunity against ERS to their offspring, Koopman says. Broiler chicks appear to be vulnerable to ERS at a very young age



“ERS is very costly for producers because of the high mortality, poor flock performance and increased condemnation rates.”

DR. RIK KOOPMAN

or from egg transmission and need to acquire immunity against ERS as soon as possible. The vaccine is labeled for protection against weight loss caused by

ERS and for reduction of virus replication in the target organs. Initial experience with the vaccine in Poland has yielded good results.

The standard protocol for vaccinating with Nobilis Reo ERS is two doses of the vaccine administered intramuscularly in the thigh or breast muscle at least 11 weeks apart but no later than 4 weeks before the onset of lay.

The safety profile of the new vaccine is good and similar to other Intervet/Schering-Plough Animal Health reovirus vaccines, Koopman says.

“Since reovirus problems cause significant economic losses to the poultry industry, preventing the ravages of reovirus infection is crucial. Vaccination is an important tool for controlling the damage,” he says.







# STOPPING SUBCLINICAL COCCIDIOSIS



What harm is a little coccidiosis that appears late in a broiler's life cycle? Apparently a lot, according to studies by a poultry nutritionist at Oklahoma State University, USA, who's presented his work recently in Europe and at other international poultry conferences.

In this special report, *Intestinal Health* looks at the most recent research on late-breaking, subclinical coccidiosis and how results in the lab are consistent with what's happening in the real world.



## Late coccidiosis challenge has ‘profound’ impact on profits

A coccidiosis challenge late in the production cycle has a profound, negative effect on energy utilization, flock performance and profitability — even when coccidial gut lesions are minor, indicates expansive research by a US nutritionist.

“I have never conducted a nutrition study with the order of magnitude that this study revealed about the impact of intestinal health on energy utilization,” Dr. Robert Teeter, of Oklahoma State University, said during a talk on the economic impact of subclinical coccidiosis in broilers.

His findings, which are being borne out in the field (see article, page 21), show that when broilers experience a coccidiosis challenge late in the production cycle, they use up more energy and need more feed compared to birds challenged with coccidiosis early in the production cycle. The result is increased malabsorption, reduced effective caloric value and an elevated maintenance cost, Teeter said.

The researcher and his team measured the effect of coccidial lesions on energy utilization, also known as the “calorific cost,” with the aid of indirect calorimetry chambers. His lab at the university has 60 of the chambers — the largest set for small animals anywhere in the world. The chambers enable measurement of values such as oxygen consumption and carbon dioxide production in real time as birds are exposed to various stressors such as coccidiosis.

Teeter also uses an X-ray densitometer (DEXA) unit to noninvasively scan birds and quantify protein, fat, water, ash and energy content. “[This technology] gives us a very complete picture of what’s happening with growth and performance,” explained the nutritionist, whose work is in part sponsored by Intervet/Schering-Plough Animal Health.

Gross lesions in the experiments are evaluated with the widely accepted Johnson-Reid Lesion Evaluation Score, where ranges from zero, indicating no intestinal lesions, to 4, the most severe lesions.



ROBERT TEETER



## Study with Cobb broilers

Teeter’s most recent experiment involved 936 Cobb male broilers raised to 48 days of age. The birds came from a variety of coccidiosis-control programs, so they had varying degrees of immunity to coccidiosis.

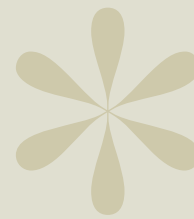
At weekly intervals, groups of the birds were moved for 6 days to the metabolic chambers and were challenged with an oral dose of *Eimeria acervulina*, *E. maxima* or *E. tenella*, three coccidial species known to wreak havoc in poultry complexes; some birds received sterile water and provided a control.

The composition of the birds — the protein, fat, water, ash and energy content — was measured before and after chamber placement with the aid of the DEXA unit. Teeter assessed bird performance and metabolism to create a broad performance-lesion score. He also measured the effects of lesion scores on calorie expenditure (caloric cost) and contrasted the effects of early versus late lesion scores on performance and dietary caloric-density cost.

Overall, performance declined as lesion scores went up. For instance, in birds with a higher lesion score, metabolizable energy (ME) declined. For 800-gram (1.76-pound) birds, ME consumption declined about 25% with a lesion score of 2, and in older, 3,000-gram (6.61-pound) birds, it fell 30%.

The heavier, older bird challenged with coccidiosis “gets hit really hard, comparatively speaking, in weight gain, feed efficiency and so forth,” Teeter said, adding that “not only does the younger bird have less of a physiological and metabolic impact, it also has more time available for compensatory gain.”

Average daily gain decreased about 1.5% of bodyweight in grams for each increase in the coccidiosis score, Teeter continued. At the end of the 6-day period in the metabolic chambers, average daily gain fell 40% in the 800-gram (1.76-pound) birds with a lesion score of 2, and in the 3,000-gram (6.61-pound) birds with a lesion score of 2, there was no gain at all (see Figure 1).



*“I have never conducted a nutrition study with the order of magnitude that this study revealed about the impact of intestinal health on energy utilization.”*

DR. ROBERT TEETER

*continued*



Late coccidiosis challenge has 'profound' impact on profits

ROBERT TEETER

"Gain was eliminated for these birds, so depending on how many of them you have in your population in the field, it's going to have a very marked influence on performance," he said.

These findings indicate that a 2,000-gram (4.4-pound) bird with a lesion score of 1 is going to be gaining 30 grams (0.06 pound) less per day; if it has a lesion score of 2, it will gain 60 grams (0.13 pound) less per day, he said.

#### Effect on feed efficiency

The effects of coccidial lesions on feed efficiency were similarly negative. Each increase in the coccidiosis lesion score was associated with a decrease in feed efficiency of 0.0084% of bodyweight. Put another way, the feed-conversion ratio increased from 2.0 to 3.02 in a 2,000-gram (4.4-pound) bird.

With the aid of an energy model that predicts ME consumption and by looking at kilocalories — which is 1,000-gram calories — lost in excreta, Teeter also determined that the 800-gram (1.76-pound) birds were losing

almost 31 kcals of extra energy a day if they had a coccidial lesion score of only 2. Older, 3,000-gram (6.61-pound) birds were consuming a little over 650 kcals of energy a day, indicating a good appetite, but there were many more malabsorbed calories — almost 84.

"So there's a very, very high loss from malabsorbed calories, and this just demonstrates the importance of intestinal health in a growing broiler," Teeter said. "Those intestines have to indeed be healthy for these birds to be able to extract those calories appropriately."

If producers want to achieve a bodyweight of about 2,500 grams (5.51 pounds), it's going to take about 39 days and an ME consumption just shy of 14,000 kcals in an ideal production environment. However, when stresses such as coccidiosis present, they steal energy. The bird responds by either eating more feed to compensate or by diverting calories away from what it consumed, in which case it gains less weight. "You'd have to purchase extra feed for the bird to utilize with no return on investment in the form of body tissue to market," Teeter explained.



He emphasized that in addition to coccidiosis, management factors affect energy expenditure in broilers. Lighting, for instance, reduces bird heat production about 24%; a properly administered lighting program increases the effective caloric value, or the caloric density of the diet, while a poorly managed lighting system steals energy from broilers.

Pellet quality likewise affects dietary caloric density. Compared to a mash, feeding 100% pellets results in an additional 187 kcals of energy, or less energy expended. “The more birds rest, the less time they spend eating, the

more efficient they are at eating and the less energy they expend on activity,” Teeter said.

Based on the massive amount of data produced by his study, the researcher concluded that lesions resulting from a coccidiosis challenge are associated with significant energy and performance costs. The consequences of these lesions are markedly elevated during the grower-finisher phases versus the starter phase of production.

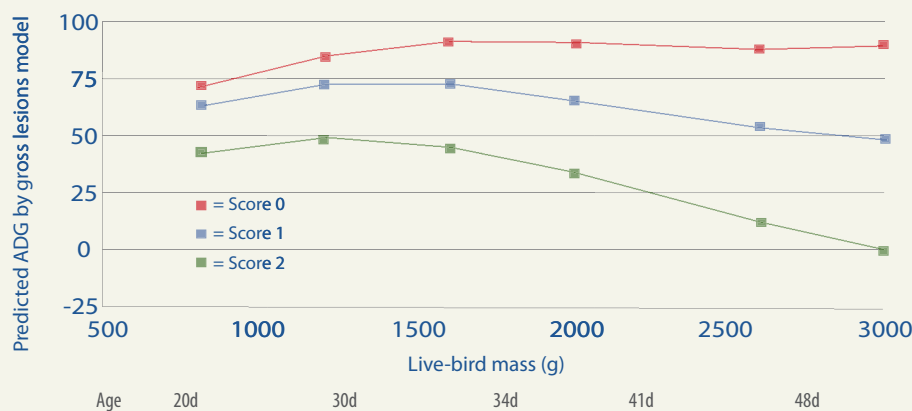
An early coccidiosis challenge, as occurs with coccidiosis vaccination administered at 1 day

of age, has a minor negative effect on feed consumption, average daily gain, live-weight yield, feed conversion, maintenance energy costs and malabsorption. When the same stress presents late in the growth curve, as occurs with in-feed anticoccidials, there is a major negative impact on all of these factors, Teeter said, noting that, “You especially want to consider malabsorption in that mix.”

“When coccidiosis challenge occurs during the final 2 weeks of the growth cycle, even minor lesions can significantly reduce flock profitability,” he added.



Figure 1. Average daily gain decreased 40% in 800-gram (1.76-pound) birds with a lesion score of 2.



Predicted ADG	@ 800 g	@ 3000 g
Score 0	71.7	91.7
Score 1	63.9 (-10.9%)	48.9 (-46.7%)
Score 2	42.6 (-40.6%)	-0.18 (-101%)



## Field experience shows perils of late coccidiosis challenge



Real-world experience is corroborating research indicating that a coccidiosis challenge late during the production cycle takes a far more serious toll on broilers and the producer's wallet than an early coccidiosis challenge.

According to research by nutritionist Robert Teeter, a late coccidiosis challenge has a major negative impact on performance and flock profitability, while a challenge early in the production cycle has a minor negative effect (see accompanying article).

Now field data from a commercial poultry farm is proving the research true, said Dr. Linnea Newman, a consulting veterinarian with Intervet/Schering-Plough Animal Health.

The veterinarian described a trial conducted by a broiler producer in Ontario who implemented coccidiosis vaccination on his farm because he wanted to develop an antibiotic-free line of birds; he also wanted to see if vaccination renewed coccidial-oocyst sensitivity to in-feed anticoccidials.

The trial involved five flocks raised to ages 35 to 36 days. The producer collected oocyst samples and took daily weights on in-house scales. Anticoccidial control in the flocks consisted of the following:

- \* **Flock 1:** Nicarbazin-narasin
- \* **Flock 2:** Coccidiosis vaccine, no antibiotics
- \* **Flock 3:** Coccidiosis vaccine, no antibiotics
- \* **Flock 4:** Coccidiosis vaccine, no antibiotics
- \* **Flock 5:** Return to narasin anticoccidials

Birds that were vaccinated received a live-oocyst vaccine at 1 day of age in the hatchery via spray cabinet. The vaccine initiates immunity to coccidiosis during the first weeks of the bird's life, then provides lifelong protection against the disease.

### Extremely high oocyst counts

The first flock, which received in-feed anticoccidials, had extremely high coccidial-oocyst counts during the later part of the production cycle but no clinical signs, which is typical of subclinical coccidiosis.



They had been gaining weight, as expected according to the Ross standard, but weight then fell off significantly — by 292 grams; during the last 3 days, they had zero weight gain.

Dr. Teeter's research has shown that birds near market age with subclinical coccidiosis, represented by coccidial lesion scores of only 2, have an average daily gain approaching zero — and that's exactly what happened in the Canadian field trial, Newman said.

In Flock 2, which received no in-feed anticoccidials but was vaccinated against coccidiosis, oocyst counts weren't taken but weight gain improved. Flock 3, which also received the vaccine, still had high oocyst counts, but peak shedding was shifting to a time earlier in the production cycle; these birds also had improved weight gain.

High oocyst counts, Newman explained, are the result of carryover from the previous flock that was on anticoccidials. Anticoccidials allow leakage of resistant coccidial oocysts, which are still in the house and hard to destroy,

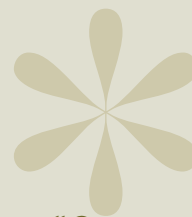
Newman said. When birds instead receive a coccidiosis vaccine, the house is gradually seeded with coccidial oocysts that have never been exposed to anticoccidials and are still sensitive to anticoccidials, but it takes a few cycles, which is reflected in the Canadian trial and by experience at Wayne Farms in the US (see article in *Intestinal Health/North America*, issue 4, page 11).

By Flock 4 and the third cycle of vaccination in the Canadian trial, "we've fallen into a complete vaccination pattern," Newman continued. Oocyst cycling was earlier and the oocyst counts lower. Weight improved 240 grams compared to Flock 1 that received in-feed anticoccidials.

### **Astounding weight improvement**

For Flock 5, the producer returned to the use of anticoccidials, which were once again effective. The difference in weight gain between the first flock and the fifth was an astounding 452 grams (0.996 pound). "That's huge. Dr. Teeter's research was correct. There's a lot to be lost if

*continued*



*"Once we establish the immunity pattern, stop the carryover effect and seed the house with vaccine strains, coccidiosis tends to become very much more predictable, lower, consistent and that's the goal."*

DR. LINNEA NEWMAN



Field experience shows perils of late coccidiosis challenge

LINNEA NEWMAN

you have coccidiosis late in the production cycle," Newman said (see Figure 1).

"It's those last 2 weeks of the flock where most of our feed is going to be consumed and it's when most of the muscle mass is being put on. That's the money part of the bird," she added.

The field trial results also bolster Teeter's finding that for every increase in the coccidiosis lesion score, average daily weight decreases by 1.5% of bodyweight, Newman added.

She also presented recent data from another Canadian producer who has used a coccidiosis vaccine continuously. "This further demonstrated that once we establish the immunity pattern, stop the carryover effect and seed the house with vaccine strains, coccidiosis tends to become very much more predictable, lower, consistent and that's the goal," the veterinarian added.

Late subclinical coccidiosis, she said, can have a measurable, negative impact on performance. "Dr. Teeter's mathematical

models really seem to do a good job of offering a measure of economic impact; they seem to be real under field conditions."

#### Vaccination reduces challenge

Vaccination, Newman continued, "offers an opportunity to manage your coccidiosis challenge. Establishment of an early, consistent immunity pattern is going to eliminate carryover and stop that cycle of resistance-building. It's going to reduce the overall coccidiosis challenge and will give you the opportunity to renew sensitivity to in-feed anticoccidials."

Vaccination, which can be used for broilers at any slaughter weight, is a process with a long-term goal, she emphasized.

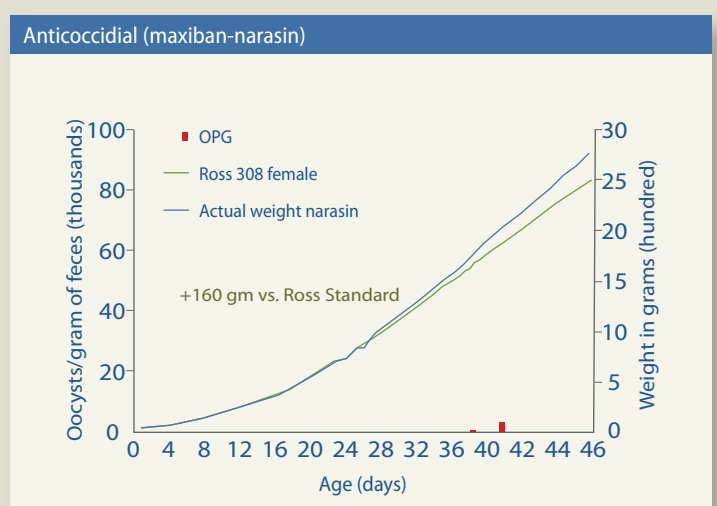
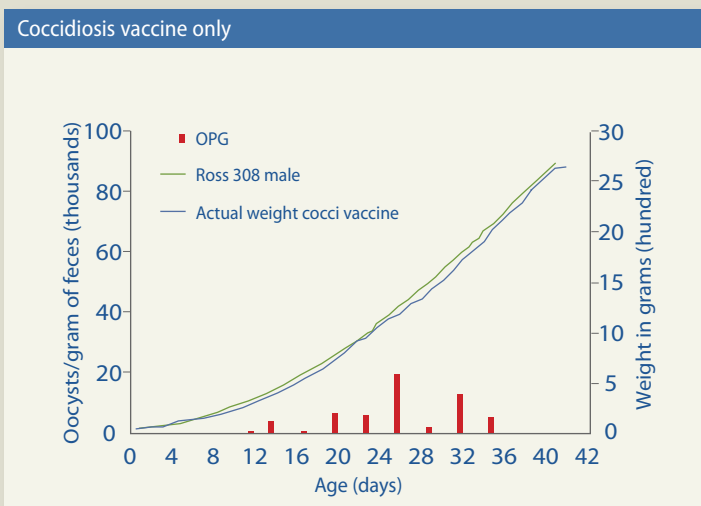
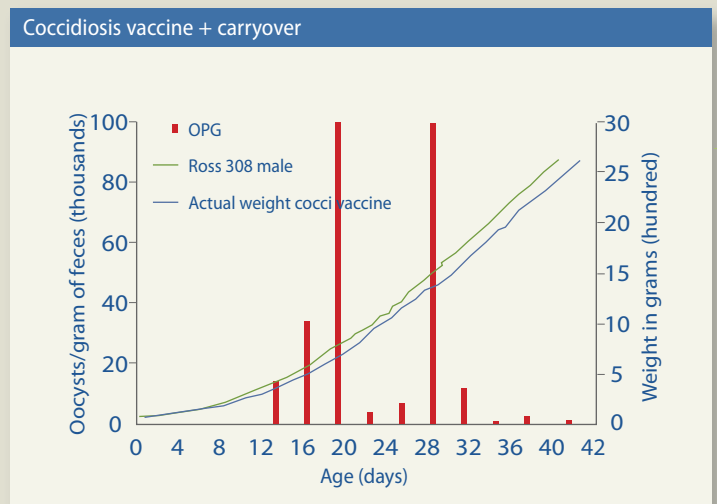
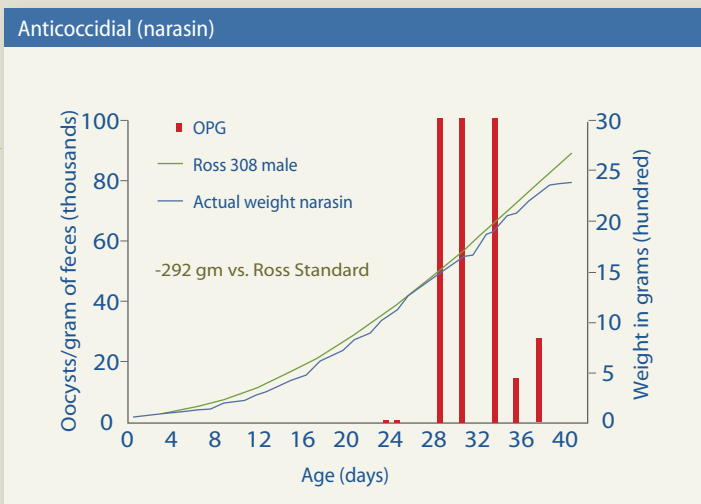
The oocyst shedding that occurs with in-feed anticoccidials tends to peak at about 4 weeks of age, close to market age. If slaughter age were at 63 days, as it was 20 years ago, then

*continued*





Figure 1. Integration of a coccidiosis vaccine into the coccidiosis-control program for three cycles shifted oocyst cycling to a time earlier in the production schedule, restored oocyst sensitivity to anticoccidials and substantially improved weight gain.



DIFFERENCE = 452 GRAMS



Field experience shows perils of late coccidiosis challenge

LINNEA NEWMAN

an oocyst-shedding peak at 28 to 35 days wouldn't matter. "At this moment, though, our coccidiosis peak and our slaughter age are directly on top of each other, and our peaks are increasing because we've lost sensitivity to the anticoccidials," she said.

Another factor to consider is that cleanout and disinfection aren't effective against coccidia. The overall numbers in the house can be reduced if the litter is removed, but generally it's not possible to kill coccidial oocysts, Newman said.

"Know what your coccidiosis challenge looks like. If oocyst counts are high, you won't get maximum performance from your birds. Keep in mind that our flocks aren't breaking with coccidiosis and this isn't complete resistance. It's just high oocyst counts, reflecting subclinical coccidiosis. They're minor lesions, but as Dr. Teeter's research and field experience demonstrate, they can have major consequences," she said.

*"Know what your coccidiosis challenge looks like. If oocyst counts are high, you won't get maximum performance from your birds."*

DR. LINNEA NEWMAN



# worth repeating

Global economic losses as a consequence of necrotic enteritis outbreaks have been estimated at over (US)\$2 billion annually. The subclinical form of the disease is considered more of an economic burden than the clinical form.

RICHARD DUCATELLE AND FILIP VAN IMMERSEEL  
GHENT UNIVERSITY  
BELGIUM

Even minimal damage to the digestive tract can be extremely costly.

ALEX MAIORKA  
FEDERAL UNIVERSITY OF PARANÁ  
BRAZIL

*Clostridium perfringens* is the fastest growing organism known and, under optimal conditions, doubles every 8 to 10 minutes. It is superbly designed to take advantage of injured tissue.

DR. JOHN PRESCOTT  
UNIVERSITY OF GUELPH  
CANADA

INTESTINAL  
health

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*Intestinal Health* is published by the Poultry Business Unit of Intervet/Schering-Plough Animal Health, Boxmeer, the Netherlands. The editors welcome your ideas and suggestions for news stories. Please send correspondence to Intestinal Health, PO Box 9000, PMB 239, Edgartown, MA 02539-9000, USA  
Fax: +1.508.629.5555  
Email: [JFeeks@prworks.net](mailto:JFeeks@prworks.net)  
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