

# COCCI FORUM

NEW STRATEGIES FOR COCCIDIOSIS MANAGEMENT

## 'THIS IS THE FUTURE'

MARTIN SHIRLEY IS LEADING THE WAY  
TO MAPPING THE *EIMERIA* GENOME

## PLUS

WAYNE FARMS: LONG-RANGE PLANNING

SPECIAL REPORT: TALKING TURKEY

TECHNICALLY SPEAKING: COMBATING COCCIDIOSIS  
IN BROILER BREEDERS

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 Schering-Plough Animal Health

NUMBER 6

# Performance



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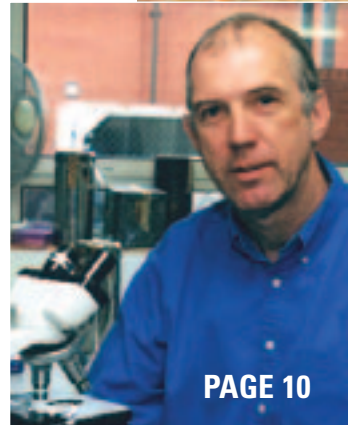
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*A cover proclaiming 'This is the Future' had better have a futuristic look. CocciForum graphic designer and production manager Deborah Sottile met that challenge using, among other images, an actual map of the Eimeria genome supplied by Dr. Martin Shirley of the Institute of Animal Health, Compton, England. For more on Dr. Shirley's exciting work, see the article that begins on page 10.*

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## LONG-RANGE PLANNING

New tools and strategies are helping Wayne Farms to better manage coccidiosis while optimizing both product and bird performance

Managing coccidiosis in poultry used to be a no-brainer. Simply pick the feed additives that work best in your operation and rotate or shuttle them for maximum performance and return.



Wayne nutritionist John Halley (left) with vets Don Waldrip and Marshall Putnam: 'We've totally changed our approach to coccidiosis control.'

"Ten years ago or so, we used to look at our anticoccidial usage on a 6-month basis. Now we're looking 2 or 3 years down the road," says Don Waldrip, DVM, director of animal health for Wayne Farms LLC, based in Oakwood, Ga.

“...Clinacox™ (diclazuril) is now letting poultry operations clean up houses infected by resistant wild strains of the *Eimeria* parasite while boosting feed efficiency an average of 5 points.”

"Coccidiosis management is a lot more complicated today," he adds. "You need to position certain anticoccidials by time of year, by length of

usage, by loss of sensitivity and other factors. The decision-making process on the use of coccidiostats has become more involved. Deciding which anti-coccidial to use and what frequency is increasingly more important."

The process is particularly challenging at a large operation like Wayne Farms, which every week processes some 5 million large birds — mostly 7 to 7.4 pounds — from eight integrated facilities in six states. Wayne is now the sixth largest vertically integrated processor in the United States.

### No complaints

Waldrip sees the growing complexity of coccidiosis management as a sign of progress against the costly, tenacious and ubiquitous protozoan disease that continues to challenge poultry operations worldwide.

"We used salinomycin for a long, long time," adds William Elrod, live production manager at the company's Pendergrass complex. "So when we went over to some of the other management options available, we got a significant boost in performance. It really changed our whole philosophy on coccidiosis management."

In the United States, Clinacox™ (diclazuril) — a new-generation synthetic anticoccidial that is in a different chemical family than other in-feed treatments — is now letting many US poultry operations clean up houses infected by resistant wild strains of the *Eimeria* parasite while boosting feed efficiency an average of 5 points. Looking to optimizing use of salinomycin and other ionophores, Wayne and many other progressive poultry operations are also vaccinating for coccidiosis instead of leaning entirely on in-feed anticoccidials.

The poultry industry is developing a better understanding of how to juggle anticoccidial products for maximum effectiveness. Research at the USDA, for example, has shown that vaccinating with Coccivac®-B, a live-oocyst vaccine administered to day-old chicks in the hatchery, renews the sensitivity of an on-farm coccidial population to the ionophore salinomycin.

Working through Schering-Plough Animal Health and Greg Mathis, PhD, of Southern Poultry Research, Inc., in Athens, Ga., Wayne is now monitoring sensitivities to *Eimeria* organisms from the litter of its more than 2,500 houses.

### Proactive, not reactive

“We’ve totally changed our approach to coccidiosis control, from one of using ionophore leakage to develop immunity to a more performance-driven scheme where leakage is not as important,” explains Marshall Putnam, DVM, director of poultry health at Wayne.

“We’re taking a fuller, more integrated, proactive approach to coccidiosis control,” he adds, “rather than a reactionary approach, where you post birds only when you’re not satisfied with the feed conversion and then decide to change the control program.”

In a perfect world, Waldrip and Putnam say they’d devise a set rotation using all types of anticoccidials — vaccines, chemicals, ionophores — for their more than 2,500 houses to follow. But variances in temperatures, moisture levels and other factors make it impossible to implement a rigid, universal program, especially for an operation spread over six states.

“With coccidiosis, you have to consider all your options and address it with a long-range attack plan,” Waldrip says. “At the same time, you still need to remain flexible to address the unique circumstances of each farm. The additional tools we have available



*Waldrip: ‘...you have to consider all your options and go into it with a long-range attack plan.’*

today help us accomplish that while maintaining good performance.”

Over the past 2 to 3 years, the biggest change to Wayne’s strategy has been the use of vaccination for at least three cycles in about 40% of its facilities. Wayne first used Coccivac at its operation in Laurel, Miss., where hot, humid summers traditionally intensify coccidiosis pressure.

### No Hassles at the Feed Mill

From a logistics standpoint, Wayne’s feed mills didn’t have any problem with incorporating the vaccine into their program.

“Our feed mills pay close attention to what they’re delivering and where,” says company nutritionist John Halley, PhD. “That’s important because accidentally putting an ionophore or chemical in the feed will kill the vaccine. Likewise, if you don’t medicate the birds that are supposed to get medicated, they’ll run into problems as well.”

Halley says the “secret to implementation success” is keeping everyone in the loop, from the decision-makers to the feed mill manager to the drivers.

“Feed mills conduct trials at certain periods of time, so they are well-acquainted with how to track feed and to make sure it gets to the right place,” he says. “It hasn’t created any special challenges for us.”



*Live-production manager William Elrod (left) and broiler manager John Moore of Wayne's Pendergrass complex.*

### **Summertime cues**

Wayne now uses Clinacox — either in the starter and grower feeds for one cycle or in the grower cycle only for two cycles — to provide a foundation for its coccidiosis program. The operation then switches to Coccivac for three cycles or more in most cases.

Not wanting to lose the well-documented performance advantage of Clinacox, Wayne likes to leave at least 12 months between treatments — a goal that in reality “cycles out to 18



*Red dye in vaccine marks immunized birds while encouraging preening and assisting with vaccine intake.*

months or so, depending on where we're at with our program,” Waldrip says.

The need to rest in-feed anticoccidials has helped to fuel even more interest in vaccination. For example, one of Wayne's complexes opted to forego switching to an ionophore this past winter and stay on Coccivac until spring. One option would then be to go to the ionophore and 3-Nitro (arsenic acid) for two cycles before rotating to Clinacox during the summer. After that, the plan is to go back to the vaccine.

### **Going the distance**

Bird performance isn't exactly suffering in the meantime.

“After five cycles with the vaccine, our Pendergrass [Georgia] complex hasn't seen any downturn in performance,” Waldrip says. “In fact, for some reason, we find performance of vaccinated birds tends to get better with each successive cycle — possibly due to a shift in *Eimeria* populations.”

The only concern Waldrip has about vaccinating in winter is that some complexes may be tempted to hold birds in the partial house to save on heating costs — a situation that could expose them to higher concentrations of recycled oocysts.

“It really depends on the moisture level of the litter and weather conditions, but as a general rule, we like to see vaccinated birds turned out no later than 14 days,” he says. “If you do that and maintain a good facility with good ventilation and litter management, you shouldn't have any problems using Coccivac year-round.”

Putnam agrees. “Good management is key to the success of any health program, whether it's coccidiosis or any other poultry disease,” he adds. “Anyone who thinks they have to make a lot of changes in their program before using Coccivac has the cart before the

horse. If houses are not being managed properly or if litter moisture levels are too high, there is a possibility that any coccidiosis program may fail. Good house management is a prerequisite for the use of any anticoccidial product.”

Balanced nutrition is also critical to flock health. But in Wayne’s case, switching to a coccidiosis vaccine didn’t require changing the company’s feed regimen.

“We raise large birds, some up to 7.5 pounds, so we tend to use a fairly dense nutrient package because we’re looking for yield,” says company nutritionist John Halley, PhD.

“If you’re raising smaller birds, you need to make sure the nutrients are there to maintain performance after vaccination. You need adequate levels of vitamins E and A, a sufficient crude protein level, and make sure that the amino acids are high.”

### As good or better

Wayne keeps performance figures confidential, but according to the technical team at the company, vaccinating for coccidiosis instead of using a feed additive has helped to maintain or even improve performance.

“We’ve used Coccivac in several locations for 2 or 3 years now and we can’t tell any significant difference in performance between vaccinated birds and those treated with an ionophore with 3-Nitro,” Halley says. “It’s been our experience that vaccinated birds perform as well or, in some cases, even better. The vaccine also lets us break up the use of the feed additives, so they’ll be more effective for us in the future.”

John Moore, broiler manager at Wayne’s Pendergrass facility, has heard similar reports from other complexes.



*Vaccinated chicks aboard the Wayne bus that will take them from the hatchery, where they’re vaccinated for coccidiosis, to the grower.*

“The vaccinated birds might start off a little slower, but they get over the initial reaction quickly and make up for lost time,” he says. “Our weights are the same or possibly better.”

## Maintaining Uniform Coverage and Protection



*Shane Ford gets ready to refill tank of Spraycox spray cabinet.*

The development of new technology for administering Coccivac has helped Wayne seamlessly incorporate vaccination into its coccidiosis-management program.

For example, the specially designed Spraycox™ spray cabinet, which USDA approved for use with Coccivac in 1997, showers crates of 100 chicks with a uniform dose of vaccine. The red dye in the vaccine encourages preening among the chicks, which in turn helps to circulate the vaccine. The dye also serves as a good marker.

“The dye helps us spot check spray patterns and coverage, but it’s not the total indicator,” says Pendergrass hatchery manager Shane Ford. “We also check the dosage regularly to make sure it’s delivering 21 ml of vaccine. We also keep the reflectors and the electric eye clean.”

In addition to a backup spray cabinet, Wayne also keeps a Spraycox™ Jr. — a hand-held applicator introduced last year — as a backup to the main online spray cabinet or to spot treat any boxes of birds.

## SCHERING-PLOUGH'S TECH SERVICE TEAM ANSWERS QUESTIONS ABOUT MANAGING COCCIDIOSIS

*Charles Broussard, DVM*

*Steve Fitz-Coy, PhD*

*Lanny Howell, DVM*

*Linnea Newman, DVM*

*John McCarty, DVM*

*Rick Phillips, DVM*

*John Radu, DVM*

**Q.** COCCIDIOSIS VACCINES FOR POULTRY HAVE BEEN AROUND SINCE THE 1950s. WHY ARE WE HEARING ABOUT THEM MORE NOW?

**A.** Several reasons. In a nutshell: Traditional, in-feed anticoccidials such as salinomycin and other ionophores have been so widely used that resistance to them is developing, resulting in coccidiosis outbreaks. Furthermore, consumer demand has increased for birds raised with fewer drugs in the food chain. Immunization offers a more natural approach for control of coccidiosis in poultry. In recent years, new methods of administering coccidiosis vaccination have been developed to ensure better uniformity and efficacy than in the past.

**Q.** DOES IMMUNITY INDUCED BY COCCIDIOSIS VACCINATION AGAINST ONE COCCIDIAL SPECIES PROVIDE CROSS-PROTECTION AGAINST OTHER COCCIDIAL SPECIES?

**A.** No. Immunity against one particular coccidial species is specific and will not protect against another coccidial species. Consequently, vaccines each contain several species of coccidia known to be a problem in the targeted bird population. That's how broad protection against coccidiosis is achieved with vaccines.

**Q.** WON'T BIRDS DEVELOP IMMUNITY TO COCCIDIA ON THEIR OWN, WITHOUT VACCINATION?

**A.** It's possible if birds are accidentally exposed to infective oocysts. But the development of immunity also depends on how often and how long birds are exposed and they may not be exposed to all the various species of coccidia that could pose a problem down the road. The development of natural immunity also may not be realized until at least 6 weeks of age.

In other words, the development of adequate natural immunity soon enough to meet the needs of poultry producers cannot be guaranteed. That's why the acquisition of immunity through controlled exposure by vaccination is preferable.

**Q.** CAN RESISTANCE TO COCCIDIAL ORGANISMS DEVELOP WHEN VACCINATIONS ARE USED TO MANAGE COCCIDIOSIS?

**A.** No. Vaccination enables birds to naturally develop lifelong immunity against coccidia, which helps prevent the development of coccidiosis. No resistance develops. In contrast, in-feed anticoccidials control the development of coccidiosis by minimizing the existing population of coccidia. This is an entirely different approach to coccidiosis control that can and has resulted in the development of resistance to anticoccidials, particularly those used over a long period of time.

**Q.** CAN COCCIDIOSIS VACCINATION HELP RESTORE *EIMERIA* SENSITIVITY TO SALINOMYCIN AND OTHER IONOPHORES?



**A.** It can, as long as the vaccine used provides live, drug-sensitive coccidia. Research conducted by Dr. Harry D. Danforth, PhD, a USDA research microbiologist, has demonstrated that vaccinating with Coccivac-B — a product containing live, drug-sensitive coccidia — changes the sensitivity of coccidia on the floor of grow-out houses. More specifically, studies by Danforth showed that using this type of vaccine helped restore sensitivity to the ionophore salinomycin.

When live coccidial oocysts are delivered with the vaccine, they replicate and replace drug-resistant field strains. The coccidial population in the house shifts to the more sensitive strains. Because most ionophores work the same in inhibiting coccidia, it can be extrapolated that sensitivity should be restored for other ionophores as well. Vaccination with coccidia that are not sensitive to drugs or that are salinomycin resistant would not restore sensitivity.

Danforth's work also shows that after vaccination with a live-oocyst vaccine, an aggressive *Eimeria tenella* strain disappeared altogether and that lesions due to other species of *Eimeria* were minimized.

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**Q.** COULD VACCINATION INTRODUCE MYCOPLASMA OR OTHER DISEASES TO BIRDS?

**A.** Not if it's a high-quality product made by a reputable manufacturer. Coccivac-B, for example, is produced according to strict quality-control methods and undergoes multiple tests

to ensure purity. Schering-Plough Animal Health tests the product during several stages of production to make sure that final batches are free of bacteria, fungi and mycoplasma, even though mycoplasma testing for coccidiosis vaccines is not required by the USDA.

Special extra testing also is conducted when indicated. A few years ago, poultry producers were concerned about a new avian leucosis virus subgroup known as J virus. A study initiated in collaboration with the University of Delaware demonstrated that production procedures for producing Coccivac vaccines would eliminate J virus if it were present. Another similar study conducted later showed that Coccivac vaccine production also would eliminate chick anemia virus.

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**Q.** A FEW DAYS AFTER BIRDS ARE VACCINATED FOR COCCIDIOSIS, SOME ARE STILL STAINED FROM THE DYE USED IN THE VACCINE TO CHECK FOR UNIFORM COVERAGE. DOES THE PRESENCE OF THE DYE MEAN THAT SOME OOCYSTS FROM THE PRODUCT HAVE NOT BEEN INGESTED?

**A.** Chicks are attracted to reds and other primary colors, so the red dye in a coccidiosis vaccine actually encourages preening by chicks in the hatchery. The ingestion of oocysts occurs immediately following vaccination. The lingering presence of the dye indicates that the birds have in fact been properly vaccinated, but does not mean that any vaccine has gone unused.

*Have more questions about coccidiosis vaccination? Send yours to the editor at [JFeeks@prworks.net](mailto:JFeeks@prworks.net) or by fax to 928-569-2491. You'll get a personal reply from a Schering-Plough Animal Health Corporation technical service representative and we may include it in our next issue of **CocciForum**.*

## 'THIS IS THE FUTURE'

IAH's Martin Shirley is leading the way to mapping the *Eimeria* genome and developing an even better understanding of *Eimeria* and coccidiosis in poultry

**F**or the moment, coccidiosis can wait.

Dr. Martin Shirley has just put in another long day at his lab in Compton, England, where the world-renowned coccidiologist serves as principal scientist for the Institute of Animal Health's division of molecular biology.



*Shirley and Tomley: 'By sequencing Eimeria DNA, or unraveling its genetic code, we can open up the parasite...and come up with thousands of potential targets for control.'*

After stopping home to squeeze in some house painting and taking a long walk through the quiet countryside, he's ready to unwind at a pub in his hometown of Wantage — a quaint 17th century village some 50 miles northwest of London.

“Scientists are opening up the whole genome, so potentially, we can find and then tackle every gene that's linked to a particular disease situation.”

Sipping on a frothy pint of his favorite beer, he enthusiastically discusses his latest accomplishment:

Converting more than 7,500 songs from his personal CD collection to the MP3 format and cataloging them by artist and genre on his home PC, which is wired to a state-of-the-art sound system.

“And I just found a new program that will allow me to transfer all the old stuff I have on vinyl to MP3 while eliminating all the pops and scratches,” he says, clearly embracing the new technology. “So when I'm all done, I'll have everything from Dylan, Sam & Dave and the Stones to Beethoven, Mozart and Verdi completely catalogued. Every song will be only a mouse click away.”

### Cataloging coccidiosis

The following day, when he returns to his lab at IAH, Shirley is all business. He's still working at his PC, only this time he's labeling and cataloging the DNA of *Eimeria* parasites, not the vintage recordings of Led Zeppelin or Stevie Wonder.

“This is the future of coccidiosis management in poultry,” he says confidently.

“In human medicine, if you look at the number of drugs available for controlling diseases, we can effectively hit about 470 biological targets. That sounds like a lot, but not when you consider that our bodies produce something like 30,000 to 40,000 gene products. We still have a long way to go. That's one of the attractions of the human genome project. Scientists are opening up the whole genome, so potentially, we can find and then tackle every gene that's linked to a particular disease situation.

“The same is true for *Eimeria* in poultry,” he adds. “By sequencing *Eimeria* DNA, or unraveling its genetic

code, we can open up the parasite for public display, look at it, dissect it and come up with maybe thousands of potential targets for control in the future.”

### ‘Complicated’ organism

Shirley notes that *Eimeria* parasites are “complicated” organisms with perhaps up to 10,000 gene products or, put another way, 10,000 targets for either direct chemotherapeutic or biological control.

“At the moment, we have a small portfolio of coccidiosis drugs and vaccines that, while very effective, probably target no more than a half dozen biological targets, perhaps 10 at the most.

“That’s one of the reasons we’re



Shirley: *Eimeria* parasites have an affinity to change profoundly.’

sequencing the DNA of *Eimeria*,” he continues. “For all the progress we’ve made against coccidiosis in poultry, we really know nothing about the finer

## Coccidiosis Control: How Good Can It Get?

It could be argued that the poultry industry is already achieving good or at least adequate control of coccidiosis with current drugs and vaccines. Still, Shirley sees plenty of room for improvement.

“There’s a need for products to replace those that are becoming less effective, especially the older drugs that have been showing resistance,” he says.

“We also have politics to consider. Regulators in Europe and other parts of the world now have a profound interest in the drugs used to control diseases of poultry and livestock, and some products for coccidiosis have been withdrawn. So we’re left with a small portfolio of drugs and vaccines for a disease that’s ubiquitous in poultry flocks throughout the world.”

Shirley says that poultry flocks are generally infected with large numbers of coccidial parasites.

“In the UK, with drug programs, we’re often talking about 60,000 parasites per

gram of litter. That’s every gram of litter,” he says. “A poultry house might contain 2 to 3 tons of litter, so that’s a huge number of parasites developing in the face of control. Moreover, since parasites have enormous replication rates there is potential for a lot of mutation. The process may not be as fast as it is with viruses, but *Eimeria* have an affinity to change profoundly.”

Shirley also considers that the poultry industry needs to be careful when setting parameters for “good” coccidiosis control, especially with vaccines that operate quite differently from drugs.

Shirley thinks vaccines, not drugs, will pave the way to new breakthroughs in coccidiosis management. “We’re already seeing that with the development of Paracox™ and the tremendous growth of other coccidiosis vaccines like Coccivac,” he says. “Developing vaccines against parasites is a sophisticated process and presents a very difficult challenge.”



Shirley: 'The data will yield a much greater understanding of how *Eimeria* parasites go about their lifestyle.'

points of the biology of *Eimeria* parasites. For example, almost nothing is known about metabolic pathways, the mechanisms by which the parasite damages the host or of the molecules that stimulate protective immunity (i.e., how and why vaccines such as Coccivac and Paracox are so effective). All of this information is contained in the genome sequence."

Shirley says his research team at IAH

“Without doubt, the most exciting spin-off from our work has been our recent success in securing the funding of a genome sequencing project for *Eimeria tenella*...”

is concerned primarily with molecular aspects of the *Eimeria* genome, as well as the genetics of the parasites.

“Without doubt, the most exciting spin-off from our work has been our recent success in securing the funding of a genome sequencing project for *Eimeria tenella*, which causes cecal coccidiosis in chickens,” he says. “This is a fantastic outcome for the coccidiosis community worldwide, as *E. tenella* has

become the first protozoan of global veterinary importance to be sequenced on a large scale.”

### Dream team

In March 2002, Shirley, IAH colleague Dr. Fiona Tomley and Drs. Bart Barrell and Al Ivens from the Sanger Institute, Cambridge, were awarded a grant of £750,000 (US\$1.2 million) from the UK's Biological and Biotechnological Science Research Council to determine the DNA sequence for the world reference Houghton strain of *E. tenella*.

“Our previous work has shown that the genome of *E. tenella* comprises about 60 million base pairs of DNA contained within 14 chromosomes,” says Shirley, who expects to wrap up the project by June 2004. “This amount of DNA may give rise to around 8,000 to 10,000 different proteins. But at present, literally only a small handful of these proteins have been identified and only very few of the genes responsible have been characterized.”

When the project is finished in June 2004, Shirley's team will have assembled a genetic blueprint for *E. tenella* and revealed 90% of the parasite's encoded proteins. All the data generated by the project is being posted on the Internet and available to the public. Shirley says the data will allow current and future coccidiologists to identify new targets for vaccination and chemotherapy.

### *Eimeria*'s 'lifestyle'

“The data will yield a much greater understanding of how *Eimeria* parasites go about their lifestyle — for example, how they cause disease, find the correct parts of the gut in which to develop, get into the host cells, reproduce themselves, cause the host to develop immune responses, and a myriad of other biological features,” Shirley explains.

“In addition, the data will allow the biology of *Eimeria* parasites to be compared with that of close relatives, such

as *Plasmodium* (the malarial parasites), *Cryptosporidium*, *Neospora* and *Toxoplasma*. If one of these parasites invades in a particular way, for example, you can be sure that *Eimeria* probably invades the host cell in a similar way. In the research community, there's a lot of mixing and matching between these different organisms."

The sequencing initiative under way at the IAH and the Sanger Institute was provided with many letters of support from international scientists and veteri-

narians working on coccidial parasites and coccidiosis. Shirley says the funding of the work by the BBSRC represents a major push for veterinary science. "To date, the genomes of very few pathogens of purely veterinary importance have been sequenced, and none remotely as big as *E. tenella*" he says.

But Shirley and his colleagues at IAH and Sanger are not going at this alone. The UK scientists are also collaborating with sequencing efforts by

## Why Target *Eimeria*?

*Eimeria* is the most economically significant family of parasites for poultry and intensively reared livestock, according to Dr. Martin Shirley of IAH.

"Coccidiosis has most impact in the intensive poultry industry, where all 35 billion chickens raised annually are likely to become infected," he says. "Despite routine prophylaxis with anticoccidial drugs, coccidiosis costs the UK poultry industry alone around £40 million (\$64 million) a year, which is equivalent to 4.5% of the revenue from sales of live broilers."

Subclinical coccidiosis is commonplace because the efficacy of drugs is severely compromised by drug-resistant parasites, Shirley says. In the EU, coccidiosis is also considered a "severe welfare problem" causing malabsorption, weight loss, diarrhea, hemorrhaging, anemia and death.

"*Eimeria tenella* is one of the most common and pathogenic species that infect the domestic chicken and the disease of cecal coccidiosis is one of the most highly visible aspects of coccidiosis in poultry," he says. "Coccidiosis control is complex and it seems clear that sustainable control will rely increasingly on vaccination, either alone or in combination with drugs."

But don't expect coccidiosis to be eradicated any time soon.

"*Eimeria* is fantastically suited for survival and replication, especially in circumstances — warmth, moisture, high bird density — provided so wonderfully by the poultry industry," Shirley says. "For example, the oocysts have a transmission stage that is extremely robust and tough. In fact, in the laboratory, we can incubate these in bleach and the parasites still survive very well."

"The parasite itself is a bit like a Russian doll, with four discrete genomes inside it," he adds. "Once the *Eimeria* parasite gets into the host, it really kicks in with a large range of genomes."



Dr. Arthur Gruber in São Paolo, Brazil, and Dr. Wan Kiew Lian at the Universiti Kebangsaan, Malaysia.

“Arthur is doing some great research that dovetails in to the big sequencing initiative and Wan has been awarded a grant from the Malaysian government to derive the complete sequence of chromosomes 1 and 2 (each of 1 million base pairs of DNA),” Shirley says.

“These chromosomes will be sequenced in their entirety to capture all genes and, most interestingly, chromosome 2 is linked to the trait of precocious development that characterizes the attenuated parasites used in Schering-Plough Animal Health’s Paracox, the current attenuated vaccine.”

## Solving the *Eimeria* Puzzle

Scientists use one of four letters — A, C, G or T — to identify each DNA molecule within a chromosome. These letters occur in pairs (A with T and C with G) and, in total, the 14 chromosomes in the *Eimeria* organism contain about 60 million such pairs of DNA.

“This genomics project will eventually give us a precise sequence of A, C, G or T in *Eimeria*’s 14 chromosomes to create a blueprint of the *Eimeria* genome,” Shirley says.

It’s a long and tedious process, however, and one that involves, firstly, breaking each chromosome into many small pieces at random and, secondly, deriving the DNA sequence of each small piece.

“The computer then becomes very important as it examines each individual genome sequence read and works out how the random, overlapping pieces were originally assembled in the chromosome. Eventually the computer compiles a very large map for us,” he says. “It’s a bit like putting a jigsaw puzzle together.”

One of the more tricky parts of the work of the computer is to deal with the characteristic repeats in the *E. tenella* chro-

mosomes (e.g., GCAGCAGCAGCA).

“You only have to go through several hundred base pairs of sequence before you turn up a repeat,” Shirley explains. “The chromosomes of *Eimeria* are very distinctive in that they contain an abundance of repeats – but as yet we have no real idea as to the effect of these repeats on the biology of the parasites. Clearly, they must do so as we know that some genes are characterized by an abundance of the characteristic small repeats.”

One of the research group’s objectives is to see the identification of potentially new targets for vaccines or drugs against coccidiosis. For example, animal health company researchers could scan the *Eimeria* genome looking for clues for particular proteins or other features compatible with their product-development objectives.

“If they have compounds that they think are active against a particular molecular target, they can screen the *E. tenella* database to determine if the same target is present in this coccidian,” Shirley explains. “Ultimately, it is certain that the genome data will be used to effect better control of the avian coccidia.”

# COMBATING COCCIDIOSIS IN BROILER BREEDERS

**H**ow many times have you heard someone in the poultry industry say, “We’ve been doing it this way for 25 years?”

Even if some things have remained the same, 25 years has meant a lot of change in the broiler industry, especially regarding genetic progress. Consider broilers in 1976. It took about 65 days to reach 4.4 lbs (2 kg) body weight. Today, broilers reach that weight in only 35 days (Figure 1). Broilers today are also more feed efficient: 1.70 now vs. 2.50 in 1976 (Figure 2).

Improvements in efficiency due to genetic progress have a price, however. It’s more difficult to manage breeders now because they grow so fast and are so feed-efficient. If anything limits their early growth, such as poor chick quality, poor brooding conditions or disease, the result is a flock with poor body weight and uniformity of frame size.

## Impact on growth

Coccidiosis is one disease that can greatly affect growth at its most critical stage for frame size development.

In today’s highly competitive broiler industry, we strive to capitalize our pullets by feeding the least amount necessary, which places emphasis on frame size. The majority of skeletal growth in broiler breeders occurs in the first 5 to 6 weeks of life.<sup>1</sup> If birds experience either clinical or subclinical coccidiosis during this period, their frame size — and thus flock uniformity — will be greatly affected (see photo).

In a flock with poor uniformity, hens that are smaller become timid and fall even farther behind. It is easy for us to see the impact on egg production, but we often don’t realize that roosters in the same house with pullets are also experiencing coccidiosis.

Coccidiosis can become an even greater problem in male chicks since they usually are smaller than females; if they don’t surpass female weight by 50% by 5 weeks of age, we risk having poor hatchability for the life of the flock.

## The biology of coccidia

In general, the life cycle of all coccidia are similar. The bird eats a sporulated oocyst, then sporozoites are released by the grinding activity of the gizzard and penetrate the cells of the intestinal mucosa. This begins the asexual cycle of development called schizogony. Next comes the sexual phase, resulting in the release of oocysts in the bird’s feces. The entire process takes approximately 7 days.<sup>2</sup> By day 14, after initial infection, the production of oocysts usually is diminishing and ceases around 18 to 20 days. Most damage to the intestine occurs early in the parasite’s life cycle, during schizogony.

## Eimeria species

The *Eimeria* species that affect chickens are *E. acervulina*, *E. maxima*, *E. tenella* and *E. necatrix* as well as *E. brunetti*, *E. praecox* and *E. mivati*. Those of particular importance to breeder pullets and roosters are *E. acervulina*, *E. maxima*, *E. tenella* and *E. necatrix*.



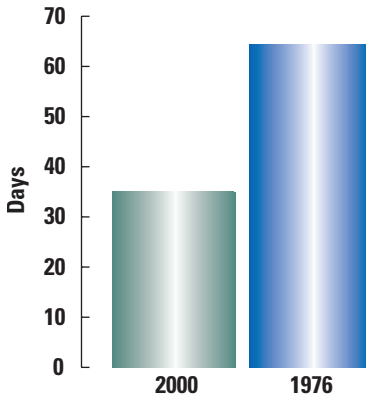
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*Flock uniformity will be greatly affected if birds experience clinical or subclinical coccidiosis from 5 to 6 weeks of life.*

**Figure 1. Days to Grow Broilers to 2 kg (4.4 lbs) Body Weight**



(Data courtesy Aviagen North America, Huntsville, AL.)

The two species that cause intestinal hemorrhage and pullet death are *E. tenella* and *E. necatrix*. *E. tenella* is also the species that causes bloody droppings, along with mortality; it is often the easiest for flock supervisors to recognize due to the characteristic blood-filled ceca of dead pullets.

*E. necatrix* usually does not cause many problems until after 6 weeks of age because it does not compete as well against other coccidia. This means that mortality caused by *E. necatrix* usually begins around 7 to 9 weeks of age; necropsy signs of white/red or white/black (salt and pepper) are seen in the mid intestine. It is also important to know that *E. necatrix* is the least immunogenic of the chicken coccidia. This will become more important when we discuss control and immune response.

“Control of coccidiosis in breeder pullets and roosters can be summarized in just one word: immunity.”

Perhaps the more economically important coccidia species the world over for pullet and rooster frame size and body uniformity are those that do not cause death but have an impact on the bird's ability to absorb nutrients from feed. The most commonly recognized are *E. acervulina* and *E. maxima*. The signs of these two species are not as obvious, so their effects are often overlooked until it is too late. Therefore, it is important to necropsy a few birds during the first 3 to 4 weeks of a pullet flock's life to determine levels of these two types of coccidia. *E. acervulina* will cause white stripes in the duodenum, while *E. maxima* may cause a ballooning of the intestine with orange mucus in the lumen.<sup>2</sup>

There are three species of coccidia that are difficult to identify in pullets when performing a routine necropsy. These are *E. mitis*, *E. praecox*, and *E. brunetti*.

*E. mitis* is normally found in the lower small intestine and produces rather indistinct lesions. *E. praecox* also does not have prominent lesions and is also often missed at necropsy. Most of the infection by *E. praecox* is in the duodenum and may result in pinpoint hemorrhages. *E. brunetti* can also affect the lower small intestine, usually around the yolk stalk. It does not produce any recognizable gross lesions. All three of these species are generally only diagnosed by microscopy.<sup>2</sup>

### Coccidiosis control

Control of coccidiosis in breeder pullets and roosters can be summarized in just one word: *immunity*. It does not matter if we are using a drug or vaccine: in both instances, the goal is to allow hens to develop life-long, lasting immunity to coccidia by 12 weeks of age.<sup>3</sup> To accomplish this goal, we must look for ways to maximize the immune response without causing a negative impact on the birds' frame size and uniformity.

Factors that affect the development of immunity are management conditions such as litter moisture, partial vs. full-house brooding and a feed restriction regimen (skip-a-day feeding). We also need to be aware of other disease or live vaccine challenges, particularly those that directly impact the immune response, such as infectious bursal disease virus, Marek's disease, chicken anemia virus and exposure to mycotoxins in feed.

**Chemotherapy.** A variety of drugs will allow enough coccidia to complete their life cycle for development of an adequate immune response in the pullet/rooster. We often refer to this partial suppression as “leakage.”

Anticoccidial drugs are broken into two broad classes: chemicals and ionophores. Chemical anticoccidial drugs that can be used to allow immunity to develop (leakage) in replacement breeders are amprolium, amproli-



um with ethopabate, zoalene and clopidol in the US. However, in Europe, many of these products are no longer available.

Amprolium has been used on many pullet farms for about 40 years, so there is a significant level of coccidia that have become resistant to this drug. Amprolium is very good against the hemorrhage-producing coccidia *E. tenella* and *E. necatrix* and it has some activity against *E. maxima*. When you add ethopabate, you broaden effectiveness to include control of *E. acervulina*.<sup>4</sup> Clopidol and zoalene are very safe for use in pullets, but resistance develops quickly. Neither of these drugs has been used extensively so they may be a good choice for control of coccidiosis in replacement breeders.

The ionophore anticoccidial drugs, such as monensin and salinomycin, are effective against all of the *Eimeria* species of concern in replacement pullets/roosters. Because they are coccidiocidal, they are used at lower doses than in broilers to allow immunity to develop.

**Vaccination.** Resistance to any anticoccidial drug develops on a farm with continuous use of the drug, which selects for those *Eimeria* that can survive. Over time, the proportion of coccidia that are resistant to the drugs increases and the result is the development of more severe lesions, which can lead to poor uniformity and adversely affect frame size. The alternative is to rotate from the anticoccidial drug to a live vaccine containing drug-sensitive strains.

Coccidiosis vaccines have two advantages. Over time, the farm's population of coccidia reverts back to being sensitive to the anticoccidial drug while the birds are vaccinated.<sup>5</sup> The vaccine also provides a "controlled exposure." This means you know exactly when the birds should experience the greatest amount of coccidia lesions, which produce immunity. In other words, you

know when to keep a close watch and provide support to the birds if needed. This can be especially important in pullet flocks that are reared in concrete floored houses or on new litter, because exposure may be delayed for these birds. The key to vaccination is that it provides all the coccidia species earlier in the bird's life than is seen with natural exposure and results in a more uniform development of immunity.

“Resistance to any anticoccidial drug develops on a farm with continuous use of the drug, which selects for those *Eimeria* that can survive.”

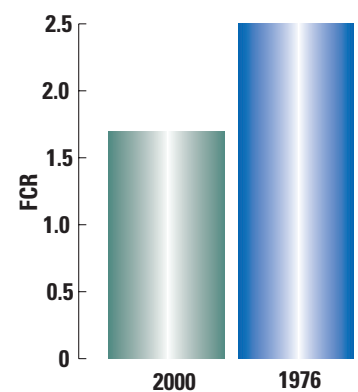
There are two types of live coccidia vaccines available worldwide: attenuated vaccines and controlled exposure vaccines. In the United States, only controlled exposure vaccines are available. This means that the coccidia vaccine given at one day of age are nonattenuated sporulated oocysts and the birds, when vaccinated at 1 day of age, will experience peak oocyst production at about 7 to 10 days of age until about 28 days.<sup>6</sup> Outside the US, there are two attenuated strains available for use in pullets. Both products produce a good immune response and may also produce fewer lesions.

It should be remembered that pullets will experience a reaction to *E. necatrix* later (6-12 weeks of age) than is seen with the other coccidia because *E. necatrix* is less immunogenic. This more predictable reaction to *E. necatrix* is another advantage to using coccidial vaccines because the reaction also normally occurs very uniformly and earlier than is seen with anticoccidial drug programs.

Keep in mind that death and bloody droppings are not the only signs to watch for during this period of "vaccine reaction." Reaction to *E. acervulina* and *E. maxima* can affect the pullet's ability

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Figure 2. Broiler Feed Efficiency Change Over Time



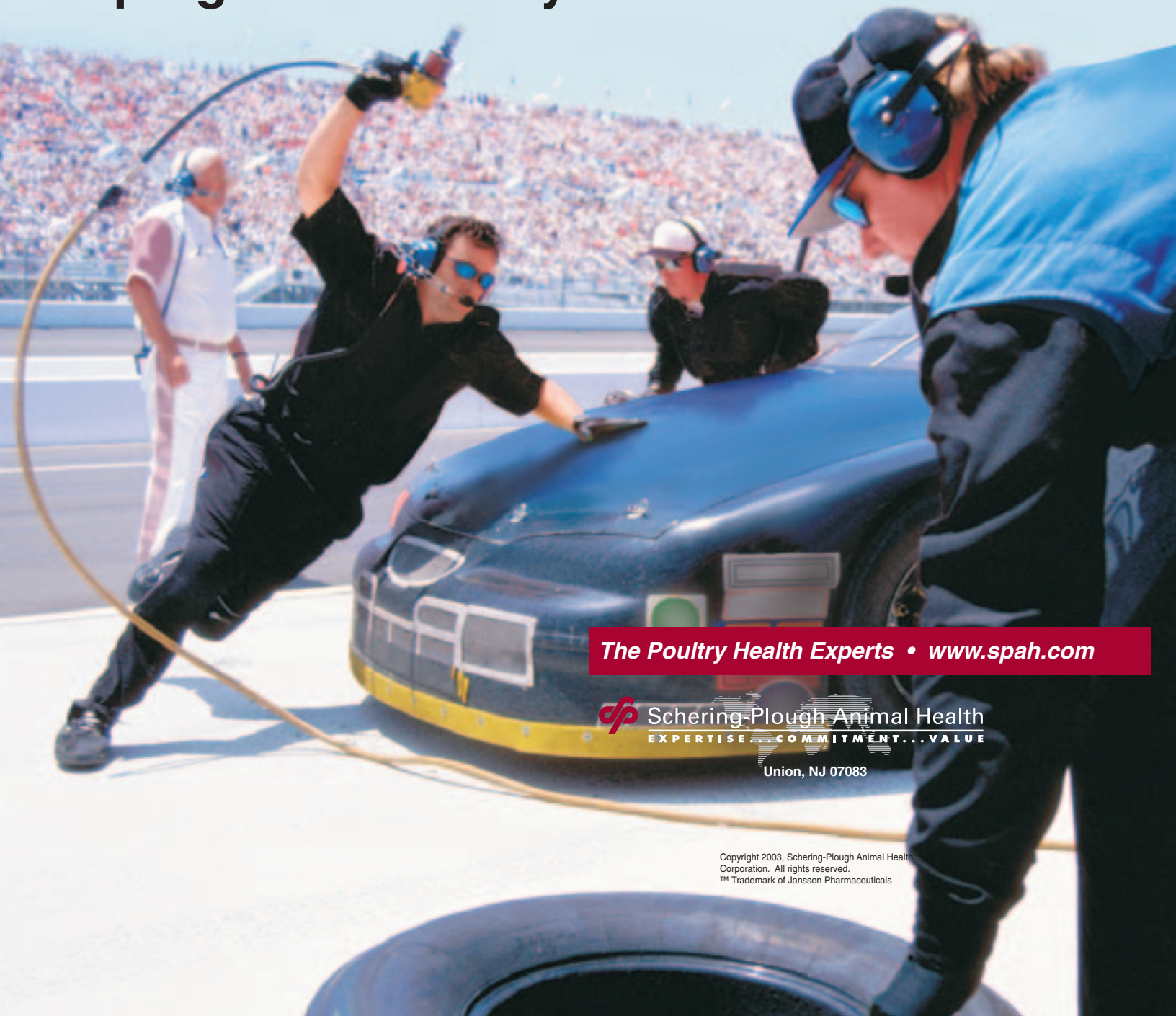
(Data courtesy Aviagen North America, Huntsville, AL.)

# Performance



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## TALKING TURKEY

Veterinarians, nutritionists and live-production managers flock to Missouri for lowdown on new approaches to coccidiosis management in growing poults

It's no secret that coccidiosis is a potentially serious problem for the world poultry industry. But while the world turkey market may be smaller in numbers, the disease and, to some extent, current management programs, have even greater potential to short-change producers on performance and profits

Here's why:

First, the cycle for growing turkeys is considerably longer than for other commercial fowl. So turkeys have a longer period of potential exposure to coccidiosis as well as other disease organisms. And any factor — whether it be disease or some other problem — that impedes a bird's uptake of nutrients is likely to have a negative impact on the bottom line

Fortunately, much progress has been made recently in controlling coccidiosis in turkeys. A recent *Cocci-Forum* conference of turkey producers held in Branson, Mo., "New Strategies for Coccidiosis Management," brought together representatives from growers representing 79 million birds, or one-third of the total US production.

### Coccidiosis: Reviewing the basics

Dr. John Radu, a technical service veterinarian for Schering-Plough Animal Health, kicked off the conference with a review of coccidiosis-management basics. His presentation included a general overview of coccidiosis in turkeys and the protozoan parasite *Eimeria* that causes the disease.

Seven species of *Eimeria* are present in turkeys, he explained, but only four are pathogenic. Those are *E. adenoides*, *E. gallapavonis*, *E. meleagridis* and *E. dispersa*.

The main source of *Eimeria* infec-

tion is from birds actively shedding oocysts of *Eimeria* in their feces. Oocysts are essentially the developing eggs of the *Eimeria* coccidia. Infection in the flock spreads as other birds peck in the litter or consume feed or water that's been contaminated by the coccidia.

"It's extremely difficult to estimate the total impact of *Eimeria* infections," Radu told attendees. "That's because *Eimeria* tends to have very complex interactions with other organisms."

Radu also said a variety of other factors such as seasonal variations in temperature and humidity (litter moisture), are particularly important. Outbreaks of coccidiosis in turkeys occur most often during colder, wetter months of the year, usually the spring and fall, but can occur at any time.

### Older birds also at risk

Another point emphasized by Radu was that, contrary to popular belief, coccidiosis can have a negative impact on *all* phases of the growing cycle. It's not just a disease of young poults 3 to 10 weeks old. True, the peak of oocyst shedding usually occurs in turkeys between days 35 and 50. But, he says, several trials have shown that variable patterns of oocyst shedding take place much later, sometimes as late as 20 weeks.

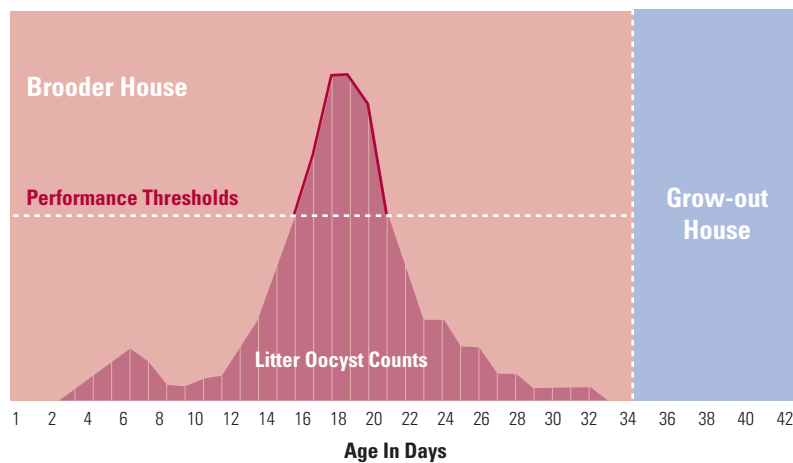
In practical terms, it's nearly impossible to entirely eradicate coccidia from



the growing environment. That being the case, most strategies for dealing with coccidiosis are aimed at maximizing control and, more importantly, minimizing losses.

One of the primary ways growers try to control coccidiosis is by the use of anticoccidials, either ionophores or synthetically manufactured chemical drugs.

**Figure 1**



Two ionophores are currently approved for use in turkeys: monensin and lasalocid. The chemical anticoccidials available for use are: halofuginone, zoalene, amprolium, and diclazuril.

“Unfortunately,” says Radu, “no ideal or perfect in-feed anticoccidial — either ionophore or chemical — has yet been developed.

“Every drug that’s available has drawbacks,” he added. “In most cases the overuse of anticoccidials will eventually lead to development of organisms with decreased sensitivity to the drug. In other cases, the use of some anticoccidial drugs may be associated with a high level of toxicity, especially if they’re used repeatedly.”

### **Anticoccidials: The downside**

The chief drawback of in-feed anticoccidials is that *Eimeria* organisms tend to develop resistance to them over time. To cut down on the development of

resistance, turkey producers have tended to rely on switching or rotating in-feed anticoccidials annually.

Still, there’s evidence to indicate some of the anticoccidial drugs work better than others. One of the presentations at the Branson conference focused on results obtained with diclazuril (Clinacox), a new-generation, synthetic anticoccidial recently approved by FDA for use in turkeys.

Dr. Lanny Howell, Bella Vista, Ark., another technical service veterinarian for Schering-Plough Animal Health, reviewed results from 19 separate trials that were conducted with diclazuril in two locations.

In those studies, 2-week-old poults, infected with coccidiosis, were placed in battery cages and fed diets containing various concentrations of diclazuril. Researchers found that birds fed diclazuril showed consistent weight gains, lower fecal counts of coccidia, and reduced mortality due to coccidiosis, than did matched infected but non-medicated controls.

Howell said researchers obtained optimal efficacy even at doses as low as 1.0 ppm.

### **Floor pen studies confirm efficacy**

Similar results have been obtained in floor pen studies. In two trials, conducted in simulated commercial conditions, investigators assessed the efficacy of 1.0 ppm against mixed *Eimeria* species in turkeys infected with coccidia at 14 or 21 days of age.

As in the battery-cage studies, investigators concluded that fecal scores for coccidia in diclazuril-treated birds were statistically lower than in controls. Weight gains were improved in the medicated birds and mortality was significantly lower as well.

Results obtained in the floor pen and battery-cage studies have also been confirmed in field studies. At the Branson conference, Howell said even large doses of diclazuril — up to 10

ppm fed for 18 weeks — didn't produce any negative clinical signs in birds. That included indices of overall clinical signs, measurements of body weight, feed conversion, hematology, and histology.

Toxicity to non-target animals or environmental toxicity can sometimes be an issue with various types of anticoccidials, especially chemicals. However, Howell reported that neither of those problems appeared to be associated with this new-generation anticoccidial, diclazuril (Clinacox).

Studies in which various non-target animals — ducks, horses, rabbits, dogs, cattle — were experimentally fed diclazuril produced no adverse effects in any of the species studied. Nor, said Dr. Howell, do studies show that diclazuril will produce any adverse environmental effects if it's released into the environment under normal poultry feed practices.

### Vaccination: A refined strategy

Though vaccination against coccidiosis has been an available option for some time now and used extensively in breeders and layers, more and more turkey growers are adding vaccination to their strategies for controlling coccidiosis.

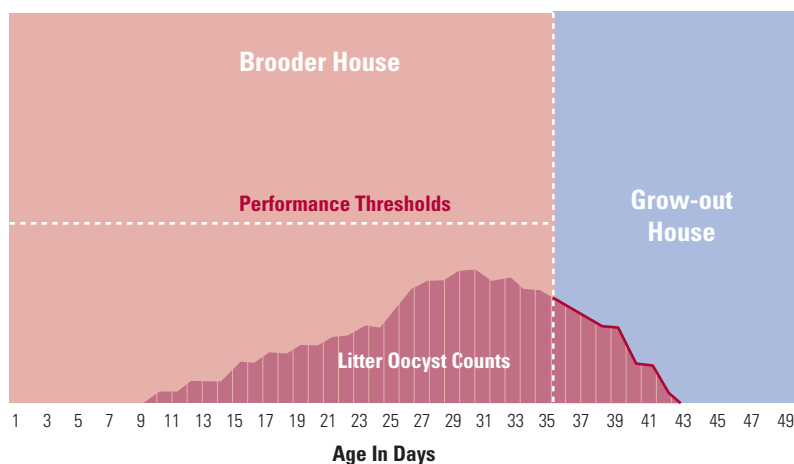
At the Branson meeting, Dr. Rick Phillips, Pineville, La., worldwide director of technical services at Schering-Plough Animal Health, outlined the rationale behind vaccination and underscored some of the reasons many turkey producers are increasingly relying on that approach.

Like other vaccines used in turkey production, coccidial vaccines aim to build immunity — in this case, against all four of the pathogenic species of coccidia that infect turkeys.

Phillips explained how one vaccine, Coccivac®-T, works: Every dose of vaccine contains a predetermined number of live, susceptible, pathogenic species of coccidia. The vaccines are adminis-

tered to poulters at an early age, usually 1 to 3 days, via a spray cabinet in the hatchery. Once the vaccine has been sprayed onto the poulters, preening and pecking results in ingestion of the vaccine and the immunity-building process begins.

Figure 2



It takes about a week for the coccidial parasite to complete its first life cycle in the bird. Then the mature parasite is excreted in the feces of each bird, and subsequently picked up by other birds. The newly ingested organisms then go through another life cycle, again taking about a week to complete. Each cycle of the coccidia — again, essentially a controlled challenge with susceptible organisms — that the bird is exposed to builds immunity.

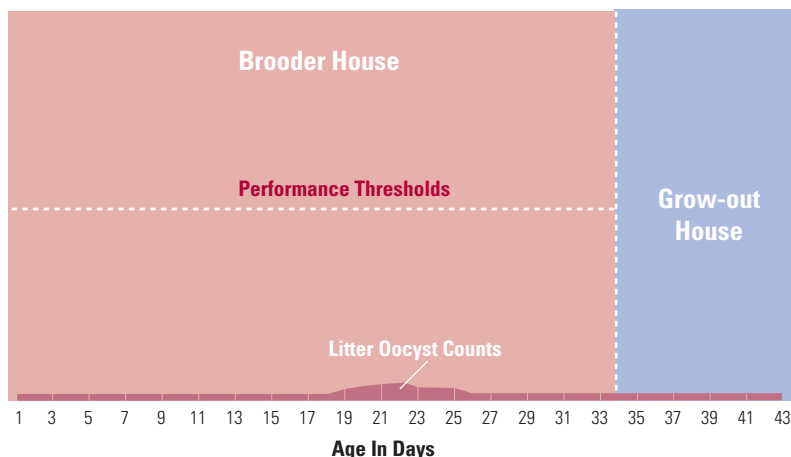
### Meeting the coccidial challenge

Phillips explained that when poulters in a brooder house are challenged by field strains of coccidia, without being treated by either in-feed anticoccidials or vaccines, levels of coccidia spiral upward above the desirable performance threshold resulting in clinical coccidiosis (Figure 1).

Though the disease is self-limiting and is usually resolved by the time the birds are moved to grow-out houses around day 35, it nonetheless can take a significant toll on overall health of the birds and resultant growth rates.

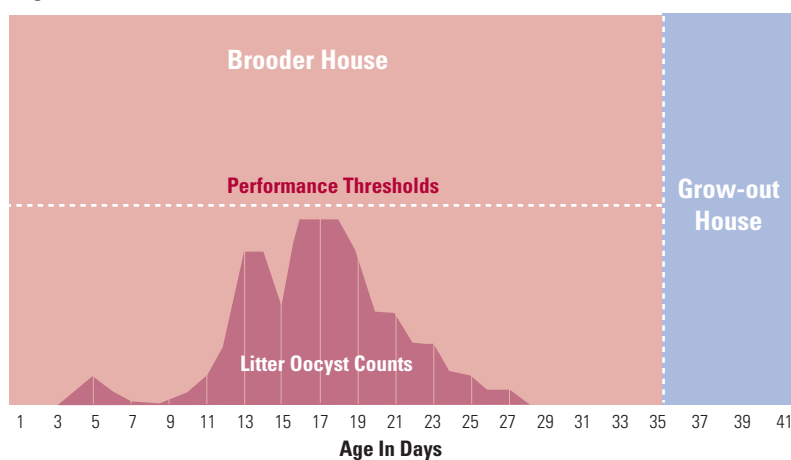
“When ionophores are used to control coccidiosis (Figure 2) the birds are challenged by the cocci, but at a reduced rate,” Phillips explained. Ionophores allow cocci to go through cycling, and that helps build immunity.

**Figure 3**



But, Phillips points out, ionophores slow down the process and levels of cocci aren't always back down to risk-free levels when the birds make their move to the grow-out house.

**Figure 4**



“And those first few days in the grow-out house are critical,” Phillips added. “It takes birds up to 2 weeks to acclimate to the new environment and to establish a new pecking order. During that time, their immune systems are suppressed due to the increased

level of stress, and that may give the cocci an opportunity to rebound.” Chemical anticoccidials produce still another result (Figure 3).

“Effective chemical anticoccidials clear the gut entirely of susceptible organisms, and leave it open for the less sensitive strains,” Phillips explained. “So if you use chemicals for several cycles you’ll see substantial resistance developing by the third or fourth time around.”

### Vaccines: The ideal option for turkeys

What about vaccines?

Phillips said they’re ideal for use in turkeys. One reason is that the growth cycle in turkeys is considerably longer than for other fowl.

“That gives them more time to catch up on any growth they may have lost due to the challenge of the vaccine,” Phillips said. “You give the vaccine on day one,” says Phillips. “You then have 21 to 28 days to build immunity” (Figure 4). You’ve given a *controlled* dose, so the coccidial exposure is mild, well below the performance threshold. And by day 28 the cycling is complete.”

The birds then have a week to fully recover from the subclinical infection before they’re moved to the stressful environment of the grow-out house.

Radu told producers about some of the results obtained using Coccivac-T, a live-oocyst coccidiosis vaccine especially formulated for use in turkeys.

In one trial, results using Coccivac-T were compared with those achieved using lasalocid (Avatec), an ionophore anticoccidial. About 300 poults were involved in the study — half were administered Coccivac-T, the other half lasalocid.

Neither group of birds showed evidence of clinical coccidiosis at any time during the trial. However, Radu stated that there was one important difference between the two treatment groups — performance.

“The Coccivac-T birds weighed significantly more than the hens that received Avatec (16.44 lbs compared with 16.04 lbs, respectively),” he said. Mortality in both groups of birds was very low.

### **Coccivac-T versus monensin**

In another trial, Coccivac-T was evaluated in comparison with monensin (Coban). More than 1,100 birds were in each treatment group. One treatment group was vaccinated with Coccivac-T at the hatchery via spray cabinet application. The other treatment group received monensin in the feed continuously for 12 weeks. After 12 weeks, the monensin was discontinued and both treatment groups were put on a regimen of virginiamycin for the remaining 6 weeks.

“At the conclusion of the 18-week study,” Radu told attendees, “both groups had performed well and there was no statistically significant difference in performance between the groups.”

One important advantage of vaccination, Radu said, is that it can be used continuously in flock after flock or in a rotation program with anticoccidials.

“When used in a rotation program it has the benefit of seeding down the litter with highly sensitive oocysts,” he added. “And that’s a big plus. It results in dilution or displacement of any resistant strains that may be present. When the switch is made to an in-feed anticoccidial, it’s likely to be more effective.”



## **Three Weapons for Battling Coccidiosis in Turkeys**

Schering-Plough Animal Health has developed three key products that are specifically targeted toward keeping turkeys healthy, from the hatchery to the processor.

Clinacox, a synthetic anticoccidial that’s been used effectively in the broiler industry for nearly 3 years, provides turkey growers a new-generation therapeutic option. It’s derived from a family of synthetic compounds not previously used in the United States.

The active chemical ingredient in Clinacox, diclazuril, has been clearly shown to be active against all the major pathogenic species of *Eimeria* that affect turkeys. And that efficacy has been confirmed in field trials, where Clinacox has been demonstrated to perform equally or better in comparison to the two major ionophores, monensin and lasalocid.

Another major weapon turkey growers have at their disposal is Coccivac-T, a live-oocyst vaccine specially formulated for use in turkeys. Growers are increasingly discovering that Coccivac-T is a cost effective alternative to in-feed anticoccidials. Poults are vaccinated on day 1. Then by the time they are transferred from brooding to finishing house, they have developed complete immunity to all major pathogenic strains of *Eimeria* — namely *E. adenoids*, *E. gallapavoris*, *E. meleagrimitis* and *E. dispersa*.

The third product that Schering-Plough Animal Health has developed is a spray cabinet that’s designed to administer a precise dose of Coccivac-T to young poults.

Until recently, Coccivac-T had been approved for administration via only two methods: mixed with water or sprayed on the feed. Though those methods have proven effective, there has always been the possibility that some poults might not be exposed to sufficient levels of the vaccine.

That possibility has been eliminated with the introduction of the new spray cabinet. With the spray cabinet method of administration, boxed groups of day-old poults are shuttled through the cabinet. The cabinet delivers a precise dose of the vaccine in spray form to the feathers of the birds. The birds ingest the vaccine as they subsequently go about their natural preening and pecking activities. Uniform delivery of the vaccine is therefore assured.

## Know Pros and Cons of Cocci-Control Options

Which coccidiosis-control methods are best to use in light of the economic constraints facing poultry producers? Greg Mathis, president of Southern Poultry Research, addressed this question in an article published last November in *World Poultry USA*.

The advantages of anticoccidials include a broad selection of products, ease of administration and long track record, Mathis says. The down side includes varied effectiveness, the potential of toxicity and, of course, resistance development.

The relatively low cost of some anticoccidials such as salinomycin has increased their use, contributing to resistance and use of lower anticoccidial levels. Producers need to weigh any savings against the risk of reduced performance, Mathis says.

Vaccination is the other primary method of coccidiosis control and its use has soared in part due to better methods of application, anticoccidial resistance and the demand for drug-free birds. Coccidiosis vaccines are easy to use, Mathis reports.

In addition, studies have shown that Coccivac-B can change a coccidial population from resistant to sensitive; Immucox may have this trait though “no information supporting this is available,” he says.

Vaccination disadvantages cited by Mathis are the “comparable cost of vaccines and anticoccidials, and the fact that live organisms must be handled carefully.” Care must be taken to ensure that nonmedicated feed is used during grow-out in vaccinated birds, but this kind of concern is diminishing as



Mathis: ‘Vaccination is a viable alternative.’

experience with the vaccines grows, he says.

A coccidiosis vaccination program can equal an ionophore program and possibly yield superior performance if a late challenge occurs.

“Thus, vaccination is a viable alternative to anticoccidials in broilers,” Mathis says.

Vaccination offers the bonus of a drug-free bird if growth-enhancing antibiotics aren’t used, and will alter coccidial sensitivity

patterns, restoring sensitivity to anticoccidials.

Mathis also provides seasonal recommendations for maximizing coccidiosis control. He advises producers to monitor for resistance, especially when chemicals are used. Although “straight” programs seem cost-effective, there’s a greater risk for resistance development. Ionophore-to-ionophore shuttle programs should be avoided and ionophores should be selected based not just on price alone, but on species efficacy. If a straight program must be used, Mathis recommends that coccidiosis vaccination be part of the yearly program to shift the resistance pattern to sensitive.

For a limited time, reprints of this educational article are available from Schering-Plough Animal Health representatives or send your name and address to phyllis.middleton@spcorp.com. Fax: 908-629-3206. Ask for SPAH-PBU-252.

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## Processed vs. Natural vs. Organic: The Final Word

As reported in the last issue of *CocciForum* (“Natural Tendencies” *CocciForum* No. 5), mainstream poultry producers are increasingly turning to vaccines to produce what consumers consider more “natural” poultry products.

But what exactly *is* “natural” and what is not when it comes to poultry products? Answering that question isn’t as simple as it might seem.

According to the USDA’s Food Safety and Inspection Service (FSIS), the term “natural” actually has nothing to do with the way an animal has been raised; the labeling poses no prohibitions against the use of drugs or vaccines.

Instead, it specifically addresses the *processing* procedures the carcass goes through after the animal has been slaughtered.

### Playing by the rules

The bottom line: The same rules for drugs and vaccines that apply to *all other* chicken products apply to so-called “natural” chicken as well: ionophoric anticoccidials (monensin, lasalocid, salinomycin) are allowed, as are growth promoters (bacitracin, virginiamycin, and bambermycin).

If those drugs are used, though, they must be withdrawn a specified period of time before slaughtered. If the producer chooses to make a perceived value-added claim about the use of drugs — in other words, “No added antibiotics” — the statement must include the amount of withdrawal time.

Over the past few years, of course, some growers have attempted to distinguish themselves from competitors by touting their birds as having received *no* sub-therapeutic levels of anticoccidials and/or growth promoters. That’s resulted in the increased use of “negative” labeling claims — “No antibiotics used....”



### Just the facts

But the FSIS says that even though many consumers consider such added claims to be an integral part of the “natural” labeling requirements, that’s not the case. Again, “natural” refers only to what happens to the product during processing, in other words, *after* slaughter, not before.

As to the added claims — such as “free-range,” “no antibiotics used,” etc. — FSIS says they can be used as long as they are backed up by facts. So if the words “No antibiotics used,” with no qualification, are printed on the label, that means that the chicken must have received no antibiotics during its entire life.

Under the “natural” label processing requirements, meat products must be no more than “minimally processed.” Roasting, smoking, freezing, drying, fermenting or meat grinding are all allowed under the “natural” labeling requirements. Processes *not* allowed under the natural label include acid hydrolysis, solvent extraction, chemical bleaching, and mechanical separation of meat.

Interestingly, the most recent official USDA directive on this issue is known as “Policy Memo 055.” It was published November 22, 1982.

### Four organic categories

And what about “organic” foods?

There are more recent changes on that front. The USDA, just this past October as the last issue of *CocciForum* was going to press, published a new set of national standards for foods labeled “organic.” The USDA set up four new categories:

- “100% organic;”
- “Organic,” defined by the USDA as containing 95% organic ingredients;
- “Made with organic,” which includes products with at least 70% organic ingredients;
- Products with less than 70% organic ingredients can’t be labeled “organic,” and can only list their organic ingredients in the contents area of their packaging.

Under the current USDA rules, poultry that’s been raised with the use of in-feed anticoccidials and growth promoters can’t carry the organic labeling (but, again, *can* carry the “natural” labeling, if it’s minimally processed).

### Leaning on vaccination

One way that growers are managing to cut down on the use of drugs in their birds — and thus attract consumers seeking chicken with less additives — is to lean more heavily on their use of vaccination, especially vaccination against coccidiosis.

“Over the past 6 years,” says Marcelo Lang of Schering-Plough Animal Health Corporation, “coccidiosis vaccination has evolved from being a technique used almost exclusively by breeder producers and broiler companies targeting *specialty* markets, to being a standard practice in today’s mainstream poultry companies.”

## Combating Coccidiosis in Broiler Breeders

to absorb vitamins, especially fat-soluble A, D, E and K. This is one reason that rickets may develop and that an increase may be seen in leg problems at around 4 weeks of age. One solution is to routinely add vitamins to the pullets drinking water during the vaccine reaction period.

### Treatment

Treatment may be necessary for various reasons. One such scenario occurs when the anticoccidial drug program begins to fail due to an increase in the number of resistant oocysts. Another scenario occurs when there is an extreme challenge before immunity has had time to develop as might occur if the litter becomes wet or there is a delay in the development of immunity after vaccination. Remember, the choice to treat may slow or even stop the development of the immune response, so the flock must be watched closely in the future for further coccidiosis. It should be noted that routine administration of anticoccidial medication to vaccinated flocks can slow or stop the development of immunity. Therefore, good flock supervision, routine necropsy of mortality and treatment only when necessary is advisable.

In the US, our choice of drugs to treat in the drinking water is limited to amprolium and the sulfa drugs such as sulfaquinoxoline or sulfadimethoxine. In addition to these drugs, toltrazuril, available in several countries outside the United States, has been a very effective medication. It is important to identify the *Eimeria* species most affecting pullets/roosters, because amprolium is more effective against *E. tenella* and *E. necatrix* (hemorrhage producers) and sulfa drugs work best against *E. acervulina* and *E. maxima*.<sup>4</sup>

### Summary

Today's replacement breeders are far more feed-efficient and grow more rapidly than they did 25 years ago. Consequently, we must do a better job managing the development of immunity to coccidia if we are to minimize the impact on skeletal frame size and body weight uniformity. There are several options available to help birds develop lifelong immunity, ranging from anticoccidial drugs to vaccines.

Whichever method is used, birds must still be closely monitored for signs of excessive coccidial damage. If we don't do a good job managing our "cocci program," we may significantly affect both egg production in hens and fertility in roosters.

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## New Approaches to an Old Disease

For an old disease, coccidiosis sure inspires a lot of innovation. The focus used to be containing coccidia with in-feed anticoccidials. It didn't seem particularly complicated. Now we're faced with anticoccidial resistance, a shrinking pool of

in-feed anticoccidials and a demand for more naturally raised birds — all at a time when competition is tough and economic pressures are high.

More poultry integrators are realizing that to achieve effective coccidiosis control, careful consideration must be given to the methods used, the time of year and length of time they are given. There's no doubt that coccidiosis control has gotten more complicated. I predict, however, that as experience is gained with newer approaches, the learning curve will minimize and the efforts will prove to be worthwhile.

Take the case of Wayne Farms in Georgia, the sixth largest vertically integrated processor in the US. Ten years ago or so, they planned their anticoccidial usage on a 6-month basis. Now they plan about 2 to 3 years ahead.

As Wayne's Dr. Don Waldrip puts it in the article that begins on page 4, "You need to position certain anticoccidials by time of year, by length of usage, by loss of sensitivity and other factors. The decision-making process on the use of coccidiostats has become more involved. Deciding which anticoccidial to use and what frequency is increasingly more important."

Now that's innovation.

Further novel approaches to coccidiosis control are likely to come as scientists learn more about the *Eimeria* parasites that cause coccidiosis. In the UK, well-known

parasitologist Dr. Martin Shirley says that despite progress in the field of coccidiosis, little is actually known about the biology of *Eimeria* parasites. Many of the answers lie in the genetic code of the organisms, which Shirley and other scientists are studying.

In fact, Dr. Shirley and colleagues have secured a grant to study the DNA sequence for the Houghton strain of *E. tenella*. The resulting "blueprint" is expected to reveal 90% of the parasite's encoded proteins. That in turn should bring about a greater understanding of key information, such as how *Eimeria* parasites cause disease and how they elicit an immune response. Data from the project, which will be made available to the public on the Internet, will help parasitologists identify new targets for vaccination and chemotherapy. Be sure to read more about these innovations in the article that begins on page 10.

In the meantime, the Poultry Technical Service Team at Schering-Plough Animal Health continues to broaden its expertise in coccidiosis control, while helping to hatch more innovation in the field. With sound science as the foundation, we plan to provide cutting-edge products to the poultry industry and continue our close association with poultry producers to help ensure the products they buy and use are as efficacious and cost-effective as possible. We'll keep you posted of new advances through personal calls, meetings, technical bulletins and, of course, future issues of *CocciForum*.

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## COCCI FORUM

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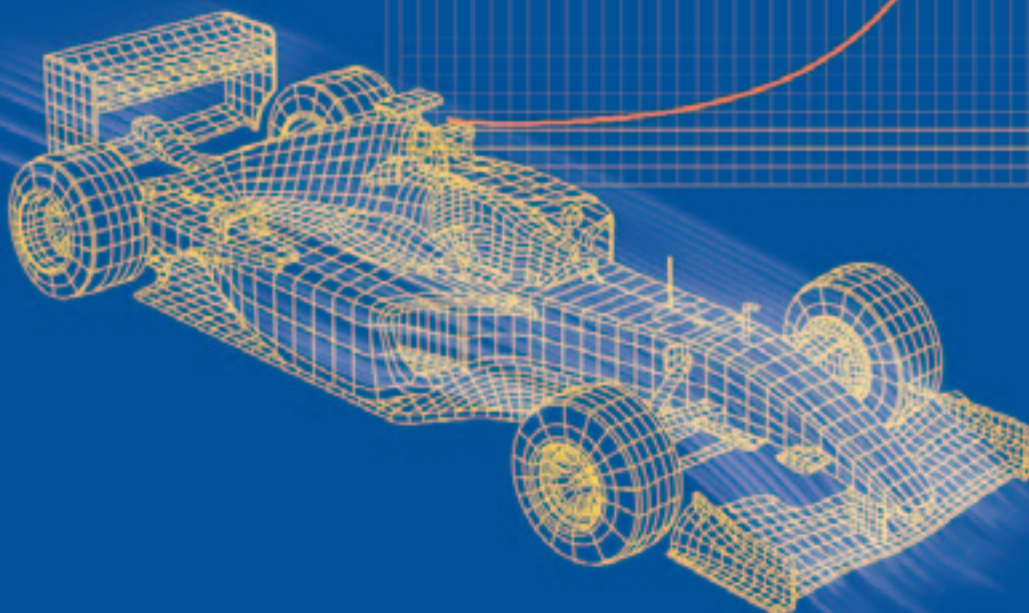
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