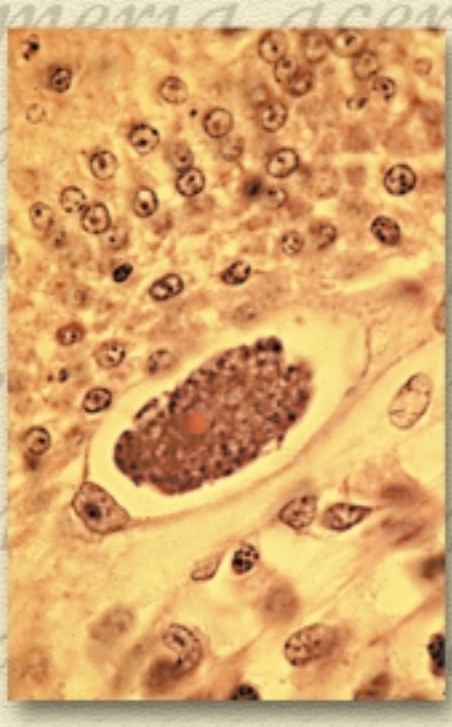
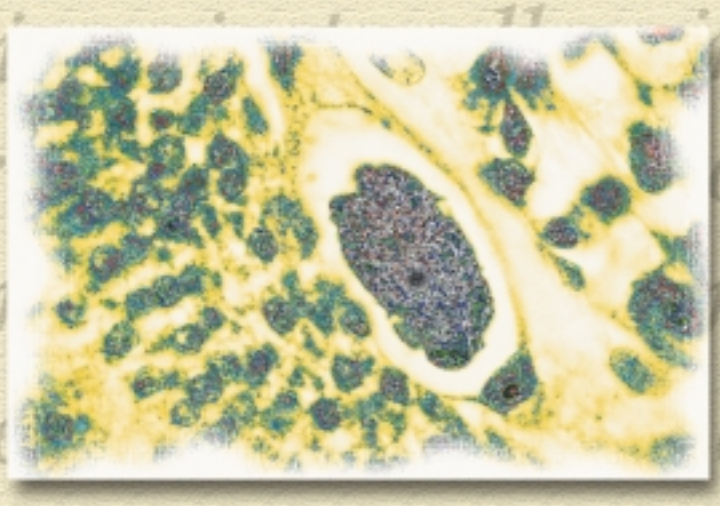
COCCI FORUM

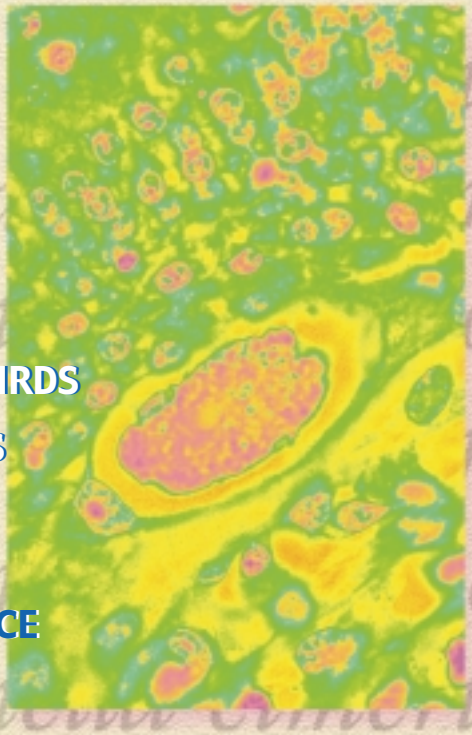
NEW STRATEGIES FOR COCCIDIOSIS MANAGEMENT

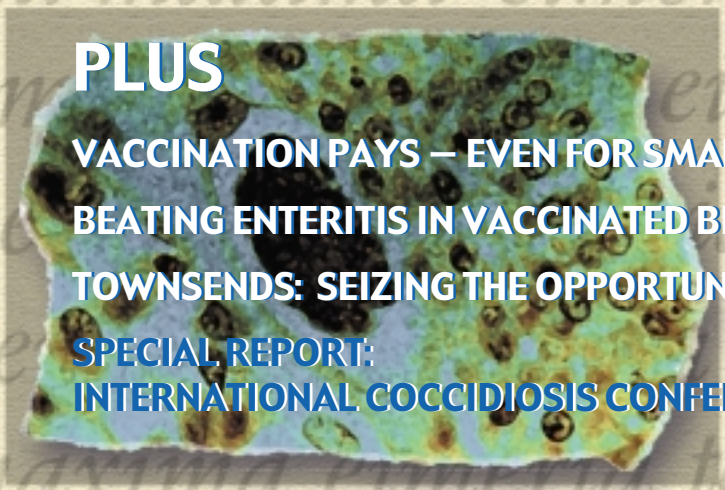




MAKE YOUR CONTROL PROGRAM STATE OF THE ART

by Dr. Martin Shirley





PLUS

VACCINATION PAYS — EVEN FOR SMALL BIRDS

BEATING ENTERITIS IN VACCINATED BIRDS

TOWNSENDS: SEIZING THE OPPORTUNITY

SPECIAL REPORT:
INTERNATIONAL COCCIDIOSIS CONFERENCE

SPAH-PBU-219

Schering-Plough Animal Health

NUMBER 4

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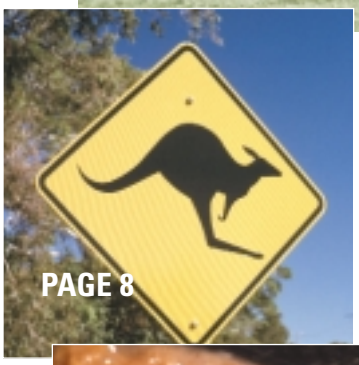
FEATURES



Cover: ***CocciForum****'s production manager — yes, magazines have them too — took artistic license with three of the four* ***Eimeria brunetti*** *images hanging in this gallery. The original appears again on page 25, courtesy of Dr. Martin Shirley, Institute for Animal Health, Compton Laboratory, U.K.*

SHARING EXPERTISE

Over the years, Schering-Plough Animal Health has gained recognition as the world leader in poultry coccidiosis vaccination. After all, we're the only company to market two lines of coccidiosis vaccines on six continents. And, in survey after survey, our technical service group continues to rank among the best in the industry.

We are proud of our progress and reputation, to be sure, but we are not about to rest on our laurels. As you'll read in the Cocci News section on pages 30 and 31, we've made several changes to further strengthen our technical service team and bring even more expertise to our customers. We have also secured product registrations in new markets to meet the growing worldwide demand for coccidiosis vaccine.

In addition, we are pleased to bring the poultry industry another issue of ***CocciForum*** *magazine — our biggest one ever.* ***CocciForum*** *has evolved into just that — a forum — where poultry disease experts, nutritionists and producers from around the world can share their ideas for managing effective and profitable coccidiosis control programs.*

While the feedback from our readers has been nothing short of enthusiastic, ***CocciForum*** *cannot realize its full potential without story ideas and other editorial suggestions from all of its readers. For that reason, I hope you'll take a moment to fill out the accompanying reply card and tell us what you'd like to see covered in future issues.*

On behalf of everyone at Schering-Plough Animal Health, I want to thank you for your support and wish you much success in 2002.

Stephen P. Collins, Vice President, Worldwide Poultry

BIG GAINS FOR SMALL BIRDS

Research, field trials show coccidiosis vaccination pays — even for lightweight birds

Broussard: 'Reactions are not as severe as industry once believed.'

To be vaccinated for coccidiosis or not to be vaccinated: For broilers raised to lighter weights, that is the question.

Why wouldn't producers want to vaccinate birds 4.2 lbs and less?

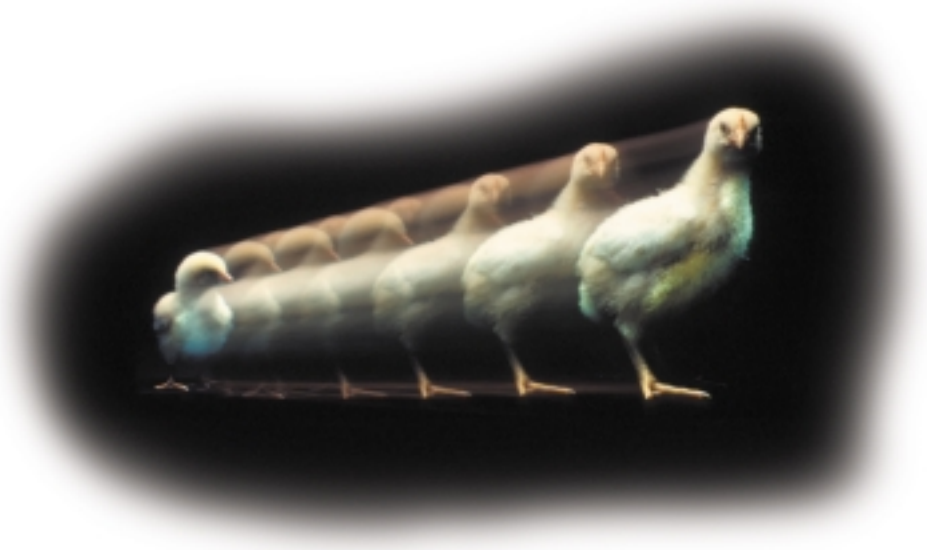
One old school of thought suggests that vaccinating birds marketed at light weights against coccidiosis results in performance loss. That's because vaccination introduces live coccidial oocysts to the chickens — a process that produces a reaction and subsequent intestinal disruption.

With vaccinated birds managed in a 40- to 42-day or even shorter production cycle, decreased feed intake and weight gain setbacks could be intensified, and perhaps never overcome.

New Evidence

Fortunately, a new school is evolving to empower small bird producers with tools for vaccination program success.

"We're learning that vaccination reactions are not as severe as industry once believed," says Dr. Charles Broussard, a technical service veterinarian with Schering-Plough Animal Health.



"There are now data to show that growth rate following vaccination is not as suppressed as originally anticipated, especially when optimum management procedures are in place and feed digestibility is increased."

According to a recent study conducted by Southern Poultry Research, Inc. (SPR), Athens, Ga., the impact on overall performance is temporary and vaccinated birds do catch up or experience what nutritionists call "compensatory gain."

In the SPR study, the vaccine Coccivac-B was administered at hatching to a group of 960 chicks in a spray cabinet. Starting at day 1, another nonvaccinated group of 960 was fed salinomycin in starter and grower feeds, according to SPR president Dr. Greg Mathis. Commencing on day 14, individual weights and feed consumption were evaluated weekly for all birds in both groups.

At day 14, average feed conversion and live weights were similar in the vaccine and salinomycin groups, Mathis reports. By day 21, the vaccinated group trailed behind the nonvaccinated group. However, after 21 days, the vaccinated birds recovered and began to gain. About day 28, performance declined in birds receiving the anticoccidial due to the presence of subclinical coccidiosis. Under normal management conditions, this is a typical occurrence when this ionophore is used, Mathis notes.

"We found that the differences between treatments quickly diminish as the vaccinated birds recovered and the salinomycin birds were slightly affected," Mathis says. "By day 35, performance in both groups was essentially the same, and remained so throughout the remainder of the study."

Diet Management for Small Birds

For vaccinated birds raised to 4 lbs at 38 days, poultry nutritionists generally recommend the following diet:

Day 1 through day 15: Starter ration with 21% protein and 1,425 calories per lb of feed.

Day 16 through day 29: Grower ration with 19.2% protein and 1,450 to 1,460 calories per lb of feed.

Day 30 through day 38: Finisher ration with 17% protein and 1,480 to 1,490 calories per lb of feed.

A leading poultry nutritionist from the United States shares the following advice and insights on feeding vaccinated birds to lighter weights. (The consultant's name is being withheld upon request.)

- Provide a well-balanced, high-quality starter feed for lighter weight birds being vaccinated.
- Be sure to keep birds eating during the grower period. Don't change management, feed or anything that would cause the birds to eat less.
- Introduce the finishing ration 1 to 2 days after the secondary coccidiosis infection subsides.
- At day 30, vaccinated birds will generally be 0.15 lb to 0.20 lb lighter than normal because of the vaccine challenge. Considering birds have 0.10 lb average daily gain over the life of the 40-day flock, determine what bird weight is at 30 days, then calculate how much growth is needed to have a finisher feed that meets the average daily gain goal.
- From day 30 to day 40, birds need to consume 102% to 103% of their normal daily feed intake.
- Expect to spend an extra $3 to $4 per ton on ingredients for the finishing ration to get the push needed to have birds ready at 40 days or less.
- If desired market weights are not achieved after the initial processing of vaccinated birds, it may be necessary to reformulate the finisher feed with increased nutrient density. This reformulation should increase compensatory gain, resulting in better market weights

No Room for Error

In order to optimize results with a vaccination program for birds raised to lighter weights, it is critical that producers follow all the manufacturer's recommended management procedures, says Dr. Linnea Newman, a consulting poultry veternarian based in North River, N.Y.

"Move these birds into the full house in 12 days or less, preferably 7 days," Newman advises. "Increased stocking density can intensify the side effects associated with a live coccidial vaccine."

Specifically, these side effects include oocyst and moisture accumulation in the litter. Heavy oocyst accumulation and high moisture can increase vaccination reaction, which is undesirable in birds destined for lighter processing weights.

"Best results will be achieved during warm weather, when good ventilation and early movement to full house will be part of the 'normal' management program," Newman points out.

Be sure to maintain at least 4 inches of a highly absorbent litter, such as wood shavings or rice hulls, Newman adds. Maintaining proper ventilation is also critical.

"If you follow these guidelines, the birds' reaction to vaccination will be minimal, allowing flocks to achieve weight and feed conversion compara-

continued on page 27

Mathis: 'Performance in both groups was essentially the same.'

SEIZING THE OPPORTUNITY

Townsends takes the Arkansas state motto to heart with innovative health program

If you travel to Batesville, Ark., in the northeast part of the state, you'll find yourself in scenic White River Valley near the foothills of the Ozark Mountains.

With a population of 11,000, the community holds the distinction of being the second oldest town in a state that calls itself the "Land of Opportunity."

The locals say teamwork, community spirit and pride thrive in Batesville. So, apparently, does innovative poultry production. Just ask Doug Helms, live production manager for Townsends, Inc.

Helms and his management team have achieved success in the broiler business in recent years. While production statistics are kept confidential, Helms says both chick quality and flock health remain high, with low mortality. According to industry tracking services that maintain producer anonymity, Townsends now ranks among the top U.S. companies based on ready-to-cook pounds per week.

Key Player

Townsends has been a key player in the U.S. poultry industry since the late 1940s. Headquartered in Wilmington, Del., the firm maintains two production centers, one in Siler City, N.C., and the other in Batesville.

All of Townsends's Arkansas production is conducted by some 200 contract growers within 75 miles of the main office. Contract farms accommodate from 20,000 layers to 120,000 broilers. Typical broiler houses run 18,000 square feet.

"We place about 950,000 chicks with our contractors each week," says Helms. Other key Batesville employees include hatchery manager Dave Kohler, breeder manager Bill Tulley and broiler grow-out manager Bruce Rutledge. Dr. Spangler Klopp, based in Georgetown, Del., serves as corporate veterinarian.

Townsends' Arkansas operation includes a company-owned processing plant and 1,000 full-time employees. Broilers are raised to 8 weeks of age and processed at over 6 pounds of body weight. All of the meat is deboned and sold under various commercial labels throughout the United States and several foreign countries.

Like many poultry firms, Townsends utilizes outside consultants, including several veterinarians and local nutritionist Dr. Phillip Hargis.

"None of us has all the answers," Helms points out. "Our consultants provide another set of eyes and another opinion to help us continually fine-tune our production protocol."

Think tank: Helms (second from right) reviews health program with (left to right) Kohler, Rutledge, Hargis and Tulley.

Health Tools

For the past 7 years, under Helms's leadership, Townsends has also developed an effective disease-control program built around vaccination. For starters, the firm vaccinates for Newcastle disease, bronchitis, Marek's disease, reovirus and Gumboro.

"Not every company vaccinates for these diseases, but it has worked well for us to do so," says Helms.

"We have used (in-feed) coccidiostats to control coccidiosis for several years," Helms adds. "With the development of the commercial live oocyst vaccine, Coccivac-B, along with the spray cabinet for application, we acquired another tool to control the disease."

For the past 5 years Townsends has maintained five cycles of birds each year. During this time the firm has vaccinated for coccidiosis from late spring to early fall, while providing coccidiostats in the feed during the other months.

"In our particular operation, we derive the greatest benefit from that particular coccidiosis preventative schedule," Helms mentions.

Besides the feed budget, the cost to protect Townsends' birds against coccidiosis is one of the company's biggest expenses — about 0.8 cent per chick, Helms says.

"We consider the coccidiosis vaccine a cost-effective tool and we use it as such," Helms emphasizes.

Vaccine Cost Benefits

"We use coccidiosis vaccine for two primary reasons," says hatchery manager Kohler. "First, it's more economical to vaccinate than it is to add coccidiostats to the feed. Our economic benefits are so great due to feed cost savings, that I believe every poultry producer should be using a coccidiosis vaccine protocol to improve his or her bottom line."

Since there are as many different management and processing regimens as there are poultry producers, it would be difficult and inappropriate to say how much money a firm could save each year by using a live oocyst coccidiosis vaccine, says Townsends veterinarian, Dr. Klopp.

"But the use of Coccivac-B is definitely an economically viable concept," he says.

According to Klopp, Townsends also uses coccidiosis vaccine because it "seeds" the operation with *Eimeria* strains that are more susceptible to older ionophores and chemical treatments.

"After a 6-month cycle of using the vaccine, we usually experience a boost in performance from the ionophores," Kohler says. "That's because the ionophores are then better able to protect against cocci, because of less resistance.

"If we do get a coccidiosis outbreak, it is easier to treat and control because the oocysts we have been vaccinating with are more susceptible — less resistant — to treatment," he adds.

Management Notes

According to live production manager Helms, litter management also helps to ensure the success of a coccidiosis vaccination program. "We make that a top priority," he adds. "All of our broiler houses are cleaned out and disinfected twice a year, spring and fall."

"We really appreciate the ease of application the vaccine spray cabinet offers," Kohler mentions. "No other form of coccidiosis control is as user-friendly."

What about chick coverage with the vaccine?

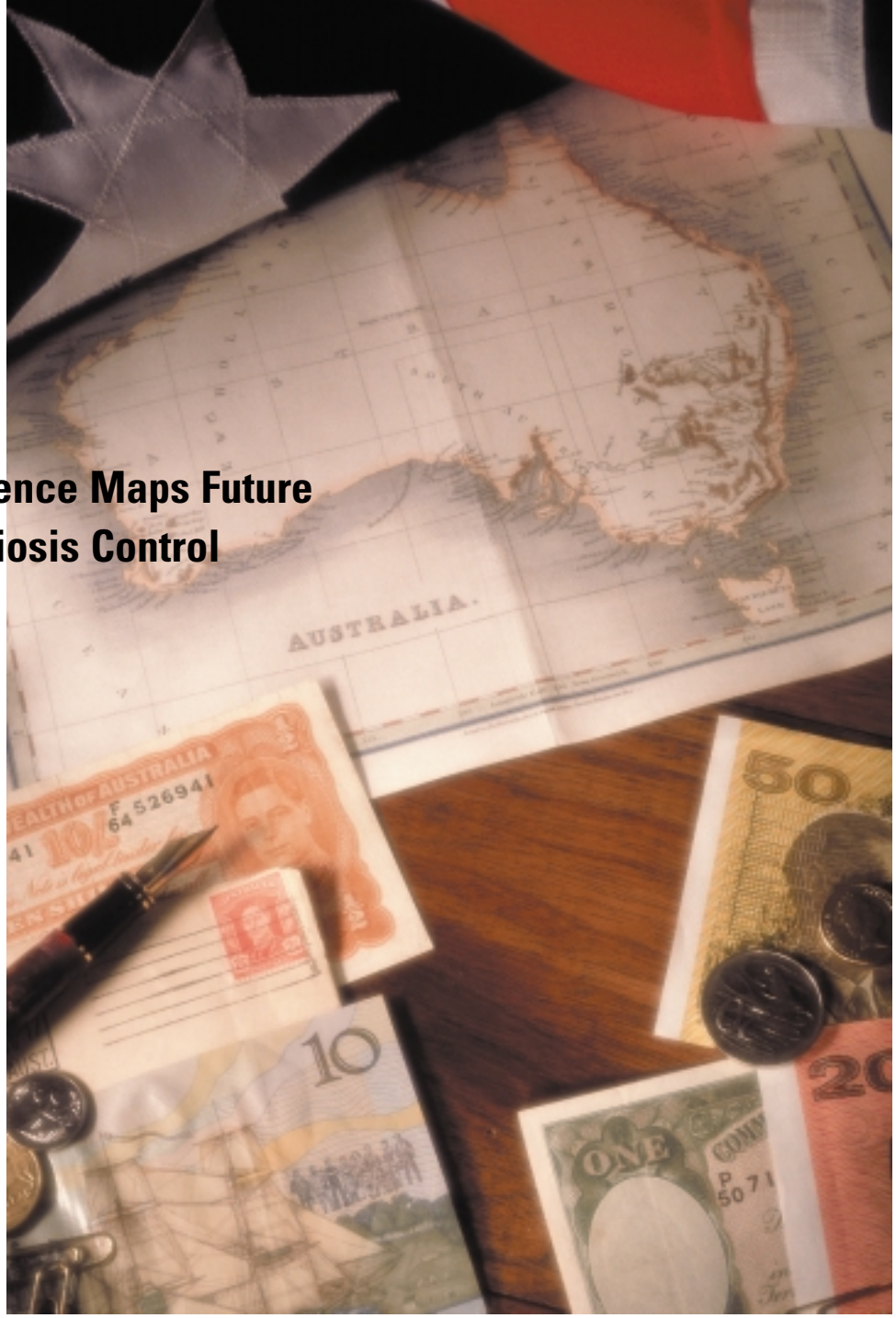
"Nearly perfect," Kohler reports. "We normally get greater than 95% 'takes,' and we often get as high as 98%. Since no vaccine is 100% effective, we don't concern ourselves with the small percentage that doesn't get covered."

According to Dr. Rick Phillips, a Schering-Plough Animal Health veterinarian based in Louisiana, the red dye

continued on page 28

Helms: 'We consider the coccidiosis vaccine to be cost-effective…'

special report



International Conference Maps Future Direction for Coccidiosis Control

The tropical far north of Queensland, Australia, seems a world removed from broiler houses or research labs, but in July 2001 it was the gathering place for some of the best scientific minds in the business.

The 8th International Coccidiosis Conference, sponsored by the Australian Society for Parasitology, was attended by some of the world's foremost parasitologists. It was a truly international gathering. As well as the strong contingents from the United States and host Australia, there were visitors from the U.K. and Europe, Brazil, South Africa, Japan, China, New Zealand and many others.

And despite such a diverse grouping, some strong themes emerged. It revealed that efforts to meet the challenge of one of poultry's major health problems are — like many things — becoming globalized. Issues that affect the large-scale broiler producer in Georgia or North Carolina can be just as pertinent for a low-tech operation in the south of China.

For people in the poultry industry, the scientists offered a fascinating window into the future management of coccidiosis. In this overview of the conference presentations and discussions, ***CocciForum*** *takes a look at some of these themes and trends from the Cairns gathering.*

COCCIDIOSIS: TRULY A GLOBAL ISSUE

Compared with some other internal parasites, the *Eimeria* species in poultry are remarkably stable. Although there may be variability in the pathogenicity of the different species, the sudden appearance of 'hot' new strains seen with avian viruses is not usually an issue for the industry.

This could lead to the mistaken conclusion that with such a stable target like coccidiosis, control is simply a matter of finding a management system that works and sticking with it.

Nothing could be further from the truth. There are many "drivers" of change in the industry and a range of these fall outside the direct control of producers and animal health specialists. For example:

• **Consumer perceptions** Consumers are increasingly turning away from products they perceive as being "unnatural," or those containing residues from drugs or antibiotics. This is happening in markets throughout the developed world. Consumers are demanding more product information and are concerned about animal welfare, as well as the possibility of chemical residues or pathogens in the food they buy.

Fear about the transfer of antibiotic resistance to the arena of human health is emerging as another major issue for consumers. Vaccination provides the industry with a sustainable, consumer-friendly strategy.

• **Economics** The economics of production have a profound impact on animal health management, especially in such an intensive environment as broiler production. This involves not only in-house factors — feed or animal health costs, for instance — but also external forces such as market conditions.

While niche markets are developing for premium "drug-free" poultry products, there are also strong pressures to minimize production costs to keep them priced competitively.

• **Technology** Rapid advances in biotechnology are providing new insights into *Eimeria* species — what's out in the field, how they respond to different control measures, and how they interact with their host. New diagnostic techniques featuring DNA analysis are giving scientists an unprecedented close-up picture of these surprisingly complex organisms. This will help researchers develop more subtle, better targeted control measures, while continuing to improve the effectiveness of existing strategies such as vaccination and, to a lesser extent, new-generation feed additives.

• **Parasite and host** Although they are relatively stable organisms, *Eimeria* species are still traveling down the evolutionary road. As well as evolving to build up resistance to chemical and ionophore treatments, the composition of field populations is also constantly shifting. This happens partly in response to the way they are managed by growers, but there are also very complex relation-

Gene technology promises benefits, but ….

*Unravelling the genetic codes of parasites such as the **Eimeria** species in the poultry industry will help researchers understand how the organisms seem to stay one step ahead of chemical controls by evolving resistance. But don't hold your breath for a quick answer.*

Contributors to a roundtable discussion on the subject (see article, page 12) said researchers are only just beginning to explore the very complex ways that microorganisms learn to live with chemicals such as antibiotics. For example, one parasite is thought to have evolved a protein that literally "pumps" the drug away.

Developing ways to understand, let alone counteract, biological tricks like this is expected to take many years.

The message: Biotechnology offers some exciting long-term prospects, but don't expect it to deliver any quick fixes to the problems of resistance to chemical treatments.

ships that scientists are now just beginning to understand.

The relationship with the host is a very close one. As the genetic codes for the parasite and host are revealed, researchers hope to learn more about genetic factors that control the impact of coccidia on its host (i.e., virulence) or how well the host can resist or tolerate the parasite.

It's also becoming apparent that the interaction between different *Eimeria* species ingested by one bird can have an impact, as does the presence of other microflora in the gut.

This news probably won't change management practices right now, but it does point the way to the future. By learning more about *Eimeria* at this molecular level, products such as vaccines can be refined to keep ahead of the evolutionary game.

Reporter's Notebook:

Drug resistance unpredictable

*Resistance to drugs among **Eimeria** species can develop in as little as 6 months. Experience in countries such as China, where use of chemicals or ionophores to control coccidiosis is relatively recent, has shown neither rhyme nor reason to the way resistance develops.*

Scientists at the coccidiosis conference in Cairns were told that development of resistance to drugs can be gradual or sudden. Dr. Martin Shirley from the U.K. Institute of Animal Health said some drug combinations are difficult to license. And for every combination that is developed, a resistant strain will develop to match it.

Dr. Greg Mathis from Southern Poultry Research Inc., Athens, Ga., said vaccination plays an important role in combating or delaying drug resistance by replacing resistant strains with drug-sensitive lines.

Chemical Tools

The range of chemical and ionophore treatments for coccidiosis is unlikely to be extended. The era of development that started with the anticoccidial "wonder drugs" in the 1960s and 70s and progressed to the more recent ionophores is virtually complete.

The result? The poultry industry must learn to extend the lives of these products as much as possible within the constraints caused by the increasing resistance of both coccidia and consumers.

While integrating chemicals and ionophores with vaccination programs can extend product life, growers are also turning their attention back to the basics of good husbandry.

The cure-all originally offered by chemical tools cannot be totally relied upon for control of coccidiosis and other problems such as necrotic enteritis. (More than once, poultry scientists at Cairns commented that today's broiler stock seem "softer" than their predecessors. If the shield thrown up by chemical or ionophore treatments loses effectiveness, birds seem less able to deal with challenge from coccidia.)

This is leading growers to refocus on managing such areas as bird density, ventilation, moisture and litter — all factors in the uptake of oocysts by poultry.

The Search for Alternatives

As cracks start to appear in the long-term sustainability of traditional coccidiosis treatments, interest is growing in some quarters in "organic" treatments based on plant products. While the jury is still out on the effectiveness of these products, they present real difficulties for regulatory authorities when it comes to registration and quality assurance.

This is because they are based on complex organic compounds and it is not always clear what components, if any, have a therapeutic effect.

Vaccination: The Growth Area

In the meantime, vaccination is emerging as *the* strong growth area in coccidiosis management for poultry producers. This theme resounded continually throughout the week-long conference in Cairns.

Dr. Harry Danforth, technology transfer coordinator with the USDA, said new vaccines are likely to emerge, featuring different mixes of *Eimeria* species/strains. They will also be developed to match conditions in different regions or countries.

"Coccidial vaccines are now well

established in Europe, Canada and the United States, and new products are being developed in Europe and the United States as well as Australia," he said.

"Use of vaccines based on live oocysts such as Coccivac-B still has considerable potential for growth."

Danforth's comments were echoed by Dr. David Chapman of the University of Arkansas. He said the development of Paracox-5 in Europe was just one example of the way vaccines can be formulated to suit the needs of a geographic region.

The Next Generation?

There was general agreement at Cairns that the current generation of coccidiosis vaccines, which are based on live oocysts, are highly effective but still on the lower slopes of a steep growth curve in poultry industries worldwide. But scientists are still excited about the potential for the next generation of vaccines.

The "Next Big Thing" will be subunit, or recombinant vaccines. Rather than using live oocysts, they'll be focused on antigens specific to the parasite and expressed through a bacterial vector — *E. coli*, for example.

Using biotechnology tools, some of which are still very much in their infancy, this next generation of vaccines will be highly targeted and sustainable. They might be injectable or administered via a spray cabinet as some products are now.

However, the next wave of products is still very much on the research bench. Danforth said that while there's no doubt these products will eventually emerge, there is still much basic research to be done, including the mapping of the genome for *Eimeria* species.

Once that's done, specific genes can be targeted for vaccines or drug therapy.

"It'll be a tough nut to crack," he said. "Some of the genetic research being done on other coccidia such as *Toxoplasma* and *Cryptosporidium* will have spinoffs for work on *Eimeria* in poultry."

Dr. Delair Bolis (left) of Schering-Plough Animal Health reviews efficacy trial with coccidiosis vaccine.

What Lies Ahead?

If there was a common thread running through the discussions at Cairns it was: "It's time to think outside the box." These are just some of the things that could be just over the horizon:

- **Changing the basic approach** to *Eimeria* species by redefining the host/parasite relationship. Using genetic modification technology, it may be possible to create dominant strains that are easy to manage and have minimal impact on their host. The logic? Get the parasite to respond to the poultry industry's requirements rather than the reverse situation.
- **Easy-to-use diagnostic kits** that can be used in commercial situations to "map" the breakdown of *Eimeria* species present. Management programs could then be tailored to suit the specific populations.
- **Using partially drug-resistant lines** of *Eimeria* in live vaccines. This

continued on page 15

Talking Coccidiosis

Notes from the Australia Roundtable

Roundtable Participants

Dr. David Chapman, Department of Poultry Science, University of Arkansas (Chair)

Dr. Tim Cherry, Stephen F. Austin University, Texas

Dr. Harry Danforth, Technology Transfer Coordinator, USDA

Dr. Grant Richards, Eimeria Pty Ltd, Victoria, Australia

Dr. Martin Shirley, Institute for Animal Health, Compton, U.K.

Dr. Ray Williams, Schering-Plough Animal Health, Harefield, U.K.

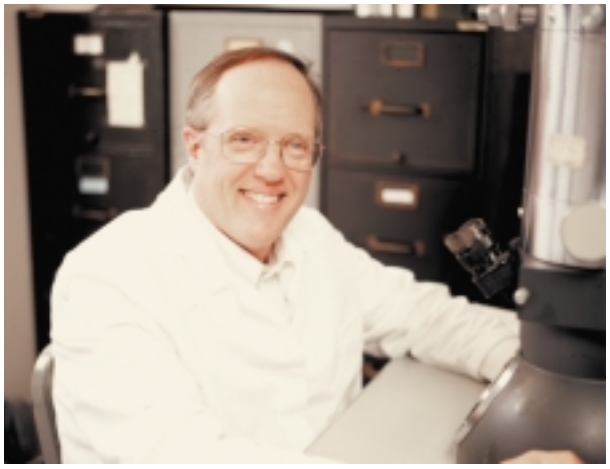
It was billed as a "controversial roundtable" and was strategically slotted on the last day of the 8th International Coccidiosis Conference in Queensland, Australia. The focus: The role of live vaccines in the sustainable control of coccidiosis in poultry production.

Led by some of the heaviest hitters in this branch of poultry science, the roundtable discussion lived up to its billing and attracted a standing-room-only crowd. Following are ***CocciForum****'s notes from this lively session.*

Take an Integrated Approach

A decision to use vaccination against coccidiosis isn't a question of 'all-or-nothing'.

While vaccination isn't currently used in the same flock with chemical or ionophore treatments, vaccination can become part of an effective rotational program, alternating with existing medication-based regimes.



Danforth: Proven treatments are emerging.

Harry Danforth gave a graphic example of how this works in practice. He has done trials that confirmed how Coccivac-B repopulated farms with coccidia that were sensitive to salinomycin. This helps enhance the usefulness of the drug if it is used in a later growout.

Watch the Arsenic

Some populations of *Eimeria tenella* — one of the most significant coccidia species — are becoming very resistant to salinomycin.

One way of dealing with this has been to use roxarsone (3-Nitro), an arsenical treatment that's been used since the 1970s and is currently used by around 60% of the U.S. poultry industry.

Danforth said that with increasing concerns about arsenic in the environment, growers' access to this tool may be limited in the future. Proven treatments such as vaccination are emerging as viable alternatives.

Keep Tabs on Coccidia

Two presenters at the roundtable explained why it is important to

understand what's happening in a flock as the coccidia respond to treatment. Looking at the numbers of coccidia, as well as what species they are, shows how the treatments are working.

Eimeria populations can be tracked by measuring how many oocysts are excreted by the birds. Dr. Ray Williams said that in medicated flocks, the oocysts per gram (OPG) counts can vary a lot, but usually peak at around week 4 or 5.

Williams also noted that, in these flocks, the coccidia can peak again toward the end of the growout after the medication is withdrawn. This can indicate that the birds are still susceptible to the disease, and the prophylaxis has only suppressed the coccidia rather than giving immunity.

In vaccinated flocks, there are typically two peaks in the output of oocysts, the first occurring usually between weeks 2 and 4. This happens as immunity is being established. The second peak represents a wild-type challenge around week 4 or 5.

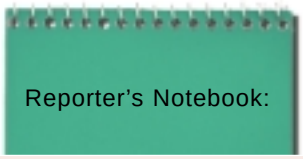
Once the second peak has passed, the OPG counts drop rapidly — a good indicator that immunity has kicked in successfully.

Danforth explained that a new diagnostic tool developed in Europe and based on molecular biology (polymerase chain reaction, or PCR) shows researchers very accurately which of the seven *Eimeria* species are involved in a flock. This is important to help design good, targeted treatments. It also helps monitor exactly how well different programs are working.

Team Up with Vaccines

Williams said that because vaccination is a biological process using live organisms, growers need to learn to work as a team with the vaccine to make sure it delivers maximum effectiveness.

The treatment depends on the birds successfully excreting a generation of vaccinal coccidia and then "recycling" them by picking them up from the litter. The uptake of coccidia is part of the build-up of immunity. To successfully "sporulate" in the environment, coccidia need the right balance of oxygen, warmth and moisture.



New drug compounds still face long road to approval

Two new feed additives recently registered in the United States have taken 8 years to make it from initial submission to final registration.

Dr. Thomas Letonja from the FDA's Center for Veterinary Medicine said the timeline is a fairly typical one for new veterinary compounds to make it through the regulatory system. And that's despite a move in 1996 to streamline the process by removing the need for the FDA to replicate the trials done by the sponsors of a new compound.

He said the caution required for human food safety assurance causes the biggest delays in the regulation process.

Letonja said the industry may already have all the veterinary drugs it needs. He noted that in Europe there was a trend to remove, rather than add, new drugs to the list of those available. At the same time, growers were starting to make more judicious use of existing compounds.

Vaccines do not require the same lengthy approval process.

If the litter is too dry, there may not be enough oocysts shed to challenge the birds sufficiently for immunization; if it is too wet, the numbers of coccidia could overwhelm the birds and cause a disease outbreak.

Williams said stocking density and access to feed are two other important factors in the birds' uptake of coccidia from litter. Good husbandry is essential.

'Compensatory Gain'

Dr. Tim Cherry said immunity in vaccinated birds is developed by 4 weeks of age. Weight gain and feed efficiency are initially affected as

Williams: Work as a team with the vaccine.

immunity develops, but birds subsequently catch up — a scenario known as "compensatory gain."

It used to be thought that vaccinated birds compensated for the initial weight gain suppression as immunity was established, usually by 4.8 lbs. But Schering-Plough Animal Health data have shown that weight gain and feed conversion in vaccinated birds are comparable to birds in coccidiostat programs after 35 days.

The Clostridial Question

Some in the industry are concerned that vaccinated birds may not receive the protection they need from clostridial bacteria. This is because the ionophores normally used to prevent coccidiosis also provide some protection against clostridial diseases like necrotic enteritis. Ionophores cannot be used with live coccidiosis vaccines, as they would compromise their performance.

Nevertheless, Williams said that in trials he's observed, necrotic enteritis affected both vaccinated birds and control groups of birds treated with a growth promoter and ionophore.

He said there's a perception in the industry that coccidiosis makes birds more susceptible to clostridial diseases like necrotic enteritis, but more research is urgently required to confirm this idea. (For more insights on managing necrotic enteritis in vaccinated birds, see page 18.)

What About Diet?

Factors such as diet could play a part in both coccidiosis and clostridial diseases. Williams said it's been shown that coccidiosis and clostridial diseases are affected by dietary changes (e.g., more or less wheat or maize content).

How this works isn't known yet, but it could be a function of vitamins or the "viscosity" of feces. The less viscous, the more easily bacteria are "flushed out" of the bird's system. More research could show how diet could play a part in coccidiosis management.

Looking Ahead

At the roundtable discussion, Dr. Martin Shirley was very enthusiastic about the future of coccidiosis control through vaccination. He expects to see the growing use of "big" vaccines (i.e., those available currently), complemented by the development of new, specialized vaccines for different markets. (See Shirley's article, page 24.)

Reporter's Notebook:

Drug resistance a problem in China

They don't do things by halves in China. Professor Mingquan Xie of the Guangdong Academy of Agricultural Sciences gave conference-goers an outline of his country's massive poultry industry. There are three native types of chicken grown — black, yellow and white — accounting for 80% of poultry output. The remaining 20% is shared between ducks and geese.

Production techniques vary from very small-scale and primitive to highly modernized units that would be more familiar to U.S. growers.

Xie says anticoccidial drugs have been abused in China, where coccidiosis tends to be worse in the hotter southern and eastern regions, including Taiwan. As a result, vaccination is playing an increasingly important role in management of coccidiosis in that country.

An evaluation of anticoccidial drugs showed that about two-thirds of the ***Eimeria tenella*** *strains were resistant to five or more different products — a worrying sign. In the trials, diclazuril performed very well, Xie said.*

He also expects to see vaccines developed to manage necrotic enteritis.

In line with the growth in vaccine use, Shirley said that concerns over the use of in-feed medication were likely to increase, especially within Europe, and the possible wider banning of some or all coccidiostat in-feed medication could now be seen on the horizon.

Shirley also predicted that biotechnology will lead the way to development of more sophisticated and targeted vaccines. This will come about as the parasite genes responsible for inducing immunity are identified, and scientists learn how to manipulate and deliver antigens. He also said biotechnology would help scientists keep up with dealing with any immunologically different (vaccine-resistant) strains should they appear in the field.

Reporter's Notebook:

Vaccination has role in organic production

Consumers in Europe are turning away from animal products that have been treated with antibiotics or synthetic chemicals and producers should take notice, according to Dr. Jean-Michel Répérant of the French Agency for Food Safety.

He told ***CocciForum*** *that some drugs are being banned in Europe. (See article, page 30.) In France, some producers are turning to unproven and unregulated plant-based treatments, which is a concern for regulatory authorities.*

However he says the trend away from the use of drugs to treat coccidiosis underlines the key role played by vaccination. He says some organic producers in France choose anti-coccidial vaccination, as this still meets the requirements of organic standards.

A Global Issue *continued from page 11*

concept appears to fly against conventional wisdom that a key benefit of vaccines is that they "reseed" poultry houses with drug-sensitive strains. Trials have shown that the drug-sensitive strains do indeed re-establish on pen floors after a flock is vaccinated, although drug resistance seems to subsequently re-emerge after several grow-outs using a drug regime.

The logic behind using drug-resistant strains in a live vaccine is that it could allow drug therapies for the control of drug-sensitive coccidial species and other organisms (e.g., clostridia) in tandem with vaccination. (At present this can't be done with most live oocyst vaccines, because anticoccidial drugs would compromise the coccidial strains used in these vaccines.) It's a radical concept but there is already one such vaccine being developed in Europe.

• **Creating a universal strain** of the species used in vaccines to deal effectively with all field strains of *Eimeria* species. This development, which would also grow out of genetic modification technology, would address the challenges posed by regional variations in *Eimeria* populations.

A reminder at Cairns that Australia, home of the cuddly koala, is also home to less endearing species.

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

Charles Broussard, DVM
Steve Fitz-Coy, Ph.D.
Lanny Howell, DVM
John McCarty, DVM
Rick Phillips, DVM

Q. IS IT TRUE THAT THE USE OF THE COCCIDIOSIS VACCINE CAN RESTORE THE SENSITIVITY OF TRADITIONAL IN-FEED COCCIDIOSTATS?

A. Yes. In fact, when used over time, the live oocyst vaccine actually helps to convert resistant field strains to strains that are more susceptible to traditional in-feed coccidiostats.

The ability of the vaccine to restore the effectiveness of in-feed coccidiostats was demonstrated in studies conducted at the USDA. Oocysts were isolated from litter samples in houses with broilers that had been vaccinated for five flocks with Coccivac-B. Oocysts also were collected from litter in houses with non-vaccinated birds treated with ionophore coccidiostats.

Next, one group of specific-pathogen-free (SPF) birds was challenged with oocysts from the vaccinated houses and another group of SPF birds was challenged with oocysts from the ionophore-treated houses. During the challenge, all birds received 60 ppm of salinomycin in the feed.

Comparison of the two groups revealed that isolates from the vaccinated houses were fully sensitive to salinomycin, while isolates from non-vaccinated houses varied in the degree of sensitivity.

In another trial, oocysts isolated from litter in a broiler house before immunization with the vaccine were compared to oocysts in litter from the same house taken after vaccination of one flock. Vaccination restored salinomycin sensitivity by seeding the house with coccidia that are sensitive to in-feed coccidiostats.

Q. IN TERMS OF MANAGEMENT, WHAT CAN I DO TO OPTIMIZE PERFORMANCE OF A COCCIDIOSIS VACCINE?

A. There are several steps that producers can take to optimize the performance of coccidiosis vaccination.

Food and water given before or after vaccination should not contain anticoccidials or other drugs that could have anticoccidial activity. Oocysts provided by the vaccine could be destroyed, thus preventing the development of immunity.

Good sanitation is important because it reduces the chances that vaccinated birds will be challenged by coccidial organisms. We suggest removing litter and thoroughly cleaning houses in between rearing cycles.

Other management methods that can improve the performance of coccidiosis vaccination include lower bird density, breeding practices, controlling access to soil and reducing litter moisture. The litter used in houses should be absorbent, such as wood shavings or rice hulls. Straw does not absorb moisture well.

Q. WHAT STEPS SHOULD BE TAKEN IN THE HATCHERY TO ENSURE BEST RESULTS WHEN ADMINISTERING A COCCIDIOSIS VACCINE?

Have more questions about coccidiosis vaccination? Send yours to the editor at jfeeks@prworks.net or by fax to 928-569-2491. You'll get a personal reply from a Schering-Plough Animal Health representative and we may include it in our next issue of ***CocciForum****. Name withheld from the printed version upon request.*

A. For starters, always follow proper vaccine mixing procedures. This includes following the manufacturer's mixing chart for correct amount of distilled water to vaccine, using the correct amount of dye (so you can spot any missed birds), and maintaining constant mixing of vaccine while it's being sprayed. Visually inspect the Carboy bottle to make sure the vaccine is being stirred.

You also want to make sure the vaccine is being properly administered. Conduct daily dosage checks and check the spray pattern on the chick box. If spray pattern from the nozzle is not even across box, remove the nozzle and clean or replace.

Lastly, always let birds sit for 20 to 30 minutes in a lighted room before loading for delivery to allow them time to preen and dry.

[Note: If you suspect any problems, contact Schering-Plough Animal Health's hatchery equipment department immediately at 800-531-0091 (U.S. only) or your local representative.]

Q. WHY DO COCCIDIOSIS VACCINES CONTAIN MORE THAN ONE SPECIES OF COCCIDIA?

A. Immunity to coccidia is species specific. Therefore, immunity developed against one species does not provide cross protection against a different species. For example, vaccinating or exposing birds to only *E. tenella* over a period of time will provide immunity or protection only to further challenges against *E. tenella.* In order to provide broad protection against coccidiosis, vaccines contain all the species considered pathogenic to poultry.

Q. MY HATCHERY PRODUCES BIRDS THAT ARE DESTINED FOR MORE THAN ONE COMPLEX. IF I VACCINATE BIRDS FOR ONE COMPLEX, IS THERE A DANGER OF EXPOSING THE BIRDS DESTINED FOR THE OTHER COMPLEX WITH COCCIDIA FROM THE VACCINE?

A. There is no danger of creating a problem with cross-contamination at the hatchery. The complex not using a coccidiosis vaccine will be using a coccidiostat for coccidiosis control. Live vaccine oocysts are highly sensitive to anticoccidials, so even if 1-day-old chicks are exposed to a full dose of the vaccine by accident, the vaccine will be eliminated by the coccidiostat in the starter feed.

Q. DO I HAVE TO ROTATE COCCIDIOSIS VACCINES WITH ANTICOCCIDIALS?

A. No. Vaccines can provide year-round protection without the buildup of resistance associated with anticoccidials. In broilers, some companies choose to rotate the vaccine and anticoccidials — perhaps three cycles with vaccine, two with a coccidiostat — due to cost (small birds) or to field-management conditions that make vaccine reactions more difficult to control in cold weather.

Q. CAN COCCIDIOSIS VACCINE BE USED IN WINTER?

A.. Yes. Coccidiosis vaccine can be used in any season as long as moderately dry litter conditions can be maintained and stocking density can be managed to control the vaccination reaction. Some companies find it difficult to use coccidiosis vaccine in winter because ventilation is reduced and birds are held in the partial house longer than 14 days.

Always follow vaccine-mixing procedures.

KEEPING ENTERITIS IN CHECK

Birds vaccinated for coccidiosis may face enteritis threat, but losses are easy to avoid with good management and common sense

Many poultry producers believe that chickens vaccinated for coccidiosis are more susceptible to necrotic enteritis than those receiving in-feed coccidiostats.

According to Dr. Tim Cherry, poultry veterinarian at Stephen F. Austin State University, Nacogdoches, Tex., this belief comes from the fact that birds vaccinated for coccidiosis receive live oocysts that enable them to develop immunity against coccidia organisms.

"For the vaccine to work, coccidial organisms have to invade the intestinal tract and reproduce, which stresses the gut," he explains. "This irritation in the gut can provide the environment necessary for *Clostridium perfringens* — already present in the gut — to produce toxins that cause necrotic enteritis."

But that doesn't mean necrotic enteritis can't be managed in birds vaccinated for coccidiosis.

As Dr. Larry McDougald, professor of poultry science and a parasitologist at the University of Georgia, Athens, puts it: "The vaccine isn't introducing anything new into the matrix."

Cherry: Live oocysts enable them to develop immunity.

Tapping Natural Resistance

Most birds are exposed to coccidia whether they receive the vaccine or not, so they're naturally vulnerable to *C. perfringens* infection. In the end, poultry specialists say, it all comes down to good management and common sense for keeping necrotic enteritis in check — regardless of whether birds are vaccinated or medicated for coccidiosis.

While it's true that coccidia — whether acquired naturally or through vaccination — introduce live parasitic organisms into the intestinal tract of birds, birds exposed to oocysts by vaccination get a *controlled* dose of *known* type, says Dr. Linnea Newman, a consulting poultry veterinarian based in North River, N.Y.

By following proven management techniques and providing proper bird space, adequate ventilation and reduced litter picking, producers can help the parasites cycle through the healthy bird's system while tapping its own natural defenses to reduce the threat of necrotic enteritis, she adds.

"We see a minimum of lesions with Coccivac-B when birds are handled well and the full level of bacitracin, virginiamycin and lincomycin is used through at least day 17," stresses Newman.

"But don't use antibiotics as a crutch," she warns. "Necrotic enteritis control has to start with good management and sanitation, which will become even more important as the poultry industry backs off or eliminates in-feed medications in response to growing consumer demand for natural birds."

Stay on Track

Factors ranging from grain type and wet litter to vaccinations and ventilation can also play a role in increasing irritation in the gut, which in turn promotes the growth of toxins resulting in necrotic enteritis.

Follow this checklist to make sure your control program is on the right track:

- **Fine tune diets.** Cut back or eliminate wheat, at least in the starter ration. Wheat has been associated with an increased incidence of necrotic enteritis, says Cherry.

Using CE Products to Tame *C. perfringens*

Can natural competitive exclusion products (CE) be used to help control necrotic enteritis caused by *C. perfringens*?

They're already used in the poultry industry to prevent salmonellosis (see article, page 22). Now some investigators are studying their effectiveness in controlling necrotic enteritis.

CE products are made of blended bacteria cultures designed to promote the growth of beneficial bacteria within the gut. They work by maintaining a healthy balance of microflora in the gut, which increases the bird's natural resistance to disease-causing bacteria.

"By promoting the growth of friendly bacteria such as *Lactobacillus* in the gut, fewer places are available for less desirable bacteria — specifically *C. perfringens* — to establish themselves," notes Dr. Linnea Newman of North River, N.Y. *Lactobacillus* also helps to acidify the gut environment, making it less suitable for clostridium growth.

As a biological control method, CE products can reduce but not eliminate the occurrence of necrotic enteritis. According to Newman, producers in drug-free production systems report that the combination of hatchery spray and inclusion of CE products in the feed has the biggest impact on necrotic enteritis.

Another method used to discourage the growth of *C. perfringens* is water acidification. According to Newman, *C. perfringens* type A likes a high pH environment. By acidifying the water, producers are able to lower the pH in the gut encouraging the growth of *Lactobacillus* while discouraging the growth of *C. perfringens*.

"The use of an antibiotic or growth promotant helps hold down intestinal irritation," adds Dr. Rex Bushong, Texan Six Consulting Firm, San Angelo, Tex. The full complement of vitamins, minerals and trace minerals should be part of the ration as well.

• **Lower bird density.** "We're at about .75 square foot per bird or 15 birds per square meter," says Dr. Harry Danforth of the USDA. "One square foot per bird or 11 birds per square meter would help control necrotic enteritis and may be necessary to control necrotic enteritis under antibiotic-free conditions."

• **Provide a cleaner environment.** *C. perfringens* is spread through feces, so good sanitation is important.

"Physical cleaning is the cheapest method of breaking the cycle of clostridial diseases," Drs. R.A. Norton

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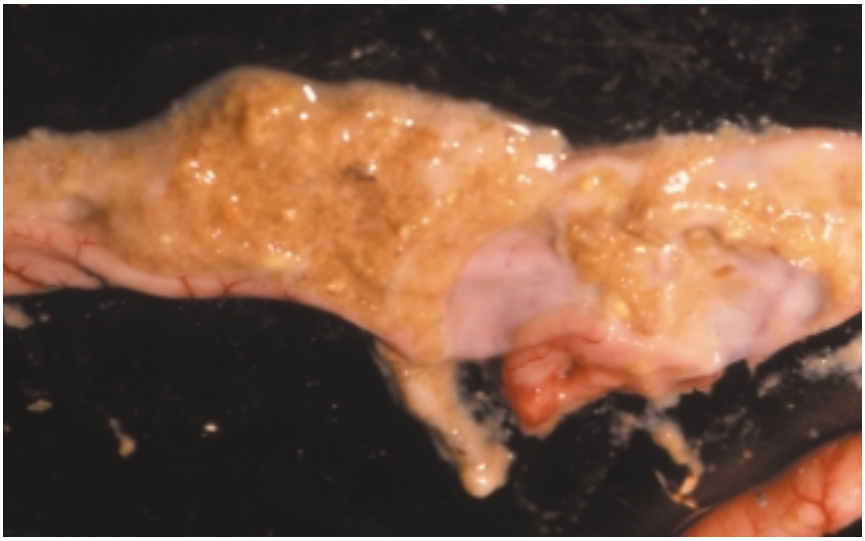
*Irritation in the gut can help **C. perfringens** produce toxins that cause necrotic enteritis.*

Photo: David Shapiro, DVM



FROM FINS TO FEATHERS

Dr. H. David Chapman is navigating sparkling new waters of coccidiosis control

Chapman and feathered friend in the lobby of the Center of Excellence for Poultry Science, University of Arkansas.

What does it take to be one of the world's leading and most respected authorities on coccidiosis?

You have to meet several rigorous criteria, says Dr. Harry Danforth, now technology transfer coordinator for USDA's Henry A. Wallace Agricultural Research Center in Beltsville, Md.

Obviously, you have to be passionate about and devoted to coccidiosis, Danforth points out.

"But you also have to be a great researcher, great teacher and a great colleague…very approachable and generous about sharing your time and expertise," he emphasizes.

So who best fits that profile?

"David Chapman," Danforth replies instantly.

Having previously worked in the world of coccidiosis research for more than 20 years, Danforth is quick to extol the exemplary qualities and qualifications of his long-time friend and colleague.

Integrated Approach

"Most notably, David Chapman has been one of the leading proponents of an integrated approach to coccidiosis control," Danforth begins. "He supports the use of live oocyst vaccines and anticoccidial drugs in well-managed rotational programs to prevent the disease."

A native of the United Kingdom, Dr. H. David Chapman obtained a B.S. degree in Zoology at Imperial College of Science and Technology, London University, and a Ph.D. in Parasitology at the University of York in the U.K. His doctoral project focused on parasites that plague our finned friends, specifically fish flukes.

Degrees in hand, he worked briefly in the pharmaceutical industry, where he conducted research in coccidiosis and liver fluke disease in cattle and sheep. In 1972 he moved to the Houghton Poultry Research Station (HPRS), a former British organization devoted to diseases of fowl. It was there Chapman immersed his energies in his life's work that would earn him tremendous notoriety and acclaim in the international coccidiosis arena.

During 18 years at the HPRS, Chapman concentrated on the mechanisms of drug resistance, which was evolving as an important economic problem during that time.

Speaking of economics, government budget cuts for agricultural research during the late 1980s prompted Chapman to research greener pastures for his professional endeavors.

A New Challenge

In 1990, Chapman was lured to Razorback country in the state where 80% of agricultural production involves poultry. He accepted a faculty position at the University of Arkansas (UA), Fayetteville, Ark. His appointment involves 90% research and 10% teaching.

With the completion of 112,000-square foot, state-of-the-art facilities in 1995, the UA Department of Poultry Science — some 30-plus faculty members strong — has become a world-class Center of Excellence for Poultry Science and the perfect venue for Chapman's research. During his tenure at UA, Chapman has developed impor-

tant scientific information with practical value to the poultry industry worldwide.

"Since I came to the University of Arkansas, my primary research interest has been exactly the same as it was in my previous position, control of coccidiosis," Chapman says.

"The first question I tackled here was whether or not you can use vaccines to restore sensitivity to drugs," he relates.

Scientific Breakthroughs

Using coccidial strains that dated to the 1950s, Chapman was the first scientist to prove that sensitivity to coccidiostats can be restored by vaccinating broilers for coccidiosis. This landmark research, highlighted in a 1994 scientific paper, has been a major breakthrough in poultry-producing regions where drug resistance was previously a problem.

The results of this project have subsequently been corroborated by a number of fellow "coccidiologists," including Danforth.

Practical Protocols

Additionally, Chapman has provided a clear understanding of the role that immunity plays in assuring the efficacy of ionophores as anticoccidial drugs. To that end, he has demonstrated how immunity produced through exposure to partially ionophore-resistant strains of coccidia works in concert with ionophore anticoccidials to ensure optimum broiler growth. As a result of this work, he has been able to recommend viable management protocols conducive to long-term coccidiosis control.

Moreover, Chapman has demonstrated that these favorable effects can be enhanced through the use of a vaccine containing drug-sensitive coccidia. He further showed that coccidia introduced through vaccination flush the resident population of drug-resistant coccidia, making the subsequent use of anticoccidial drugs more effective in broiler facilities.

To what does Chapman attribute his great success with coccidiosis research? "People describe me as 'organized' and 'meticulous,'" he relates. "I'm very detail-minded and I always strive to do things carefully, correctly and in an unbiased way."

"Considering David Chapman's many outstanding qualities, I most admire his communication skills," Danforth mentions. "He is an excellent speaker, writer and editor with a tremendous skill for organizing and relaying his thoughts and scientific information in a way that anyone involved in the poultry industry can understand and benefit from."

Chapman is the sole or principal author of more than 90 scientific publications, including many reviews and book chapters. He is a frequent featured speaker at national and international meetings.

It may sound like Chapman works all the time, but during his business travels, he often pursues his favorite hobby, bird watching.

Top Honors

In 2000, Chapman received the prestigious National Chicken Council Broiler Research Award in recognition of his profound body of work. In 2001, the coveted John W. White Research Award

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Chapman in his research lab with vials containing various strains of ***Eimeria.***

OPTIMAL RESULTS

Study shows coccidiosis vaccination doesn't deter CE products from protecting birds against *Salmonella enteritidis*

A team of scientists in the world's second largest poultry market, Brazil, has determined that coccidiosis vaccines do not compromise the ability of "competitive exclusion" or CE products to protect birds against *Salmonella enteritidis* (*Se*).

"We found that the actions of ACM (anaerobic cecal microflora) against cecal colonization and fecal excretion of *Se* are not affected by the use of coccidiosis vaccine in broiler chicks," says veterinarian and lead investigator Raphael Lucio Andreatti Filho, a professor of poultry pathology at the Universidade Estadual Paulista, Botucatu, São Paulo.

"Moreover, our results show that the ACM-coccidiosis vaccine combination can be used without reduction of the effectiveness of ACM," adds Andreatti Filho, who conducted the trial with ornithopathologists Plínio Mestrinel Junior and Homero Marcos Sampaio, plus statistician Adalberto José Crocci.

Andreatti Filho: 'Combination can be used without reduction of effectiveness.'

Understanding CE

CE products such as ACM help to maintain a healthy balance of microflora in the gut, thereby increasing the bird's natural resistance to disease-causing bacteria such as *Se*. This is important because *Se* is one of the most significant forms of *salmonellae* that is transmissible from chickens to humans. Even when broiler performance is not compromised by *Se*, the organism creates a serious public health problem — namely, food poisoning.

Se also can create a health problem for young or stressed birds. (With adult birds, the *Se* is sometimes present, but the birds don't necessarily have the appearance of being sick.) Research also has shown that the coccidial organism *E. tenella* may prolong the persistence of *Se* in the intestine, which in turn leads to a longer period of *Se* exposure in feces.

Field Trial

To see if coccidiosis vaccination had any effect on the CE product, researchers in Brazil divided 120 1-day-old broiler chicks into six groups and then implemented the following protocols:

- **Group A** received ACM by spraying on day 1, was vaccinated with the live oocyst vaccine Coccivac-B on day 2 and challenged with *Se* on day 3.
- **Group B** received ACM by intra-esophageal inoculation on day 1, was vaccinated with Coccivac-B on day 2 and challenged with *Se* on day 3.
- **Group C** received ACM through the drinking water on day 1, was vaccinated with Coccivac-B on day 2 and challenged with *Se* on day 3.

Se and Coccidiosis: A Costly Pair

Increasing the numbers of *salmonellae* in the bird's cecum — the pouch where the large intestine begins — in the presence of coccidial infection may alter the normal cecal microflora, which are the bacteria and other microorganisms that typically inhabit the intestine.

This in turn may reduce the production of volatile fatty acids, which protect against *Salmonella* colonization in the cecum. (And the coccidial organism *E. tenella* itself may also reduce volatile fatty acid production.)

Moreover, *E. tenella* infection may cause damage to the surface of the cecal mucosa, making birds more susceptible to transmission of *Salmonella* from one bird to another, or from vectors like feces, personnel, feed, equipment and/or rodents.

• **Group D** was vaccinated with Coccivac-B on day 2 and challenged with *Se* on day 3, but was not treated with ACM.

• **Group E** was challenged with *Se* on day 3, but was not vaccinated or treated with ACM.

• **Group F**, serving as the negative control, was not vaccinated, challenged or treated.

For all groups, researchers determined the colonization of the digestive tract, the presence of *Se* in feces and body weight 2, 7 and 12 days post-challenge.

Reduced *Se* Counts

"The *Se* count in the feces and cecal colonization were reduced in all three ACM-treated groups, mainly those receiving ACM by spraying and intra-esophageal inoculation," Andreatti Filho reports.

An increase in cecal colonization and fecal excretion of *Se* was observed in the groups not receiving ACM, whether vaccinated or not vaccinated for coccidiosis, he adds.

"The cecum was the main site of colonization and persistence of *Se*," Andreatti Filho says. "ACM administered by spraying or intra-esophageal inoculation reduced *Se* in feces and the cecum compared to the group receiving ACM in drinking water."

With the exception of Group C, only Group F's protocol (the negative control) led to a significantly higher body weight compared to the other groups.

Encouraging Results

"No difference in body weight was observed between the groups not treated with ACM and challenged with *Se* and vaccinated or not vaccinated against coccidiosis, thus demonstrating that the vaccine had no negative influence on weight gain in chicks challenged with *Se*," Andreatti Filho says.

"Using competitive exclusion products like ACM, a number of researchers have shown that bacterial cecal microflora from adult birds can protect newly hatched chicks challenged with *Salmonella*."

In this case, Andreatti Filho explains, "competitive exclusion" means that *Salmonella* and other pathogens will probably be reduced if beneficial bacterial microflora arrive first and establish colonies in the ceca of broiler chicks. (Usually, competitive exclusion products are prepared from undefined ACM cultures, while probiotics are made from defined cultures containing one particular type of bacteria or a prescribed combination of different bacteria.)

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COCCIDIOSIS CONTROL — MAKE YOUR PROGRAM STATE OF THE ART

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This article was adapted from the proceedings of a Schering-Plough Animal Health coccidiosis symposium held in Rhodes, Greece, October 20-21, 2000. For a complete copy of the proceedings, send your name and address to Schering-Plough Animal Health.
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Ask for SPAH-PBU-198.

For over 50 years, coccidiosis control in intensively reared broiler chickens has depended on a constant stream of new products. In the past, virtually all introductions have been anticoccidial drugs. For the foreseeable future, however, no new drugs can be expected, and it appears that only vaccines will provide the necessary innovation and new options.

Although live vaccines have been available commercially for many years, it is only recently that the momentum for their use has increased due to the availability of a new generation of live vaccines that are based on safer, precocious lines of parasites. In addition, concern among retailers over the use of feed additives and possible implications for human health have favored an increasingly "greener" approach to farming.

Replacing dietary prophylactic drugs with vaccination offers tangible practical advantages. For example, the elimination of 3- to 5-day drug withdrawal periods means that birds of a target weight can be removed from a flock whenever they are needed. In other words, producers now have it within their power to make their coccidiosis control program more flexible, meeting market demands.

Immune Detection

Seven species of *Eimeria* enter the body of the chicken. They are located within host cells deep inside the gut and are entirely dependent on the host for nutrition as they undergo massive rates of growth and multiplication.

Within just a few hours alter ingesting oocysts, the host chicken begins to respond to the infection; by around 4 days, it will have mounted the start of a specific protective immune response. The potency of this response varies depending on a variety of factors such as the size of the infective dose, but even a chicken exposed to a single intake of small oocyst numbers will develop substantial immunity to further challenge.

The Anticoccidial Drug Era

The first comprehensive descriptions of most avian coccidia were made in the 1920s and 1930s. Within just a few years, the efficacy of inorganic sulphur for preventing caecal coccidiosis was reported and opened the way for the introduction of new anticoccidial drugs into the marketplace.

The variety of different chemical drugs introduced initially was superseded at the beginning of the 1970s by the most successful of all anticoccidials — the ionophorous antibiotics. Unlike many "totally" effective chemical drugs that readily gave rise to resistant mutants, the ionophores were intrinsically less effective and each newly introduced drug allowed some parasites to develop and complete their life cycle during the course of every infection. This unique mode of action imposed weak selection pressures on coccidia and drug-resistant mutants were not reported for many years.

Ultimately, resistant strains to ionophores appeared, but the drugs have continued to remain the mainstay of coccidiosis control. The use of ionophores, however, is now tempered by the need to manage the high incidence of drug-resistant strains. This is usually achieved through the implementation of drug shuttle programmes.

The huge success of ionophores in conjunction with the more limited use of other drugs has almost certainly been one reason why several animal

health companies have reduced their search for, or interest in, the development of new anticoccidial drugs. Other factors that have impacted negatively on research to derive new drugs include the spiralling costs of product development and changing political perceptions about the role of feed additives.

A dramatic decline in the pace of new introductions has thus followed the success of the ionophores; no new anticoccidials were made available during the 1990s. Moreover, reports of potentially active compounds completing the first phase of investigation are now sparse and it appears that no new drugs can be anticipated for the foreseeable future.

Bridging Drugs and Vaccines

Against the backdrop of coccidiosis control by chemotherapy and the need for the poultry industry to adjust the use of individual drugs as their efficacy is compromised by drug resistance, immunity to parasites has played an interesting and increasingly prominent role during the past 10 to 20 years. One investigator theorized that the development of host immunity is a major factor accounting for the effectiveness of polyether ionophores, despite the existence of resistant strains of field coccidia.

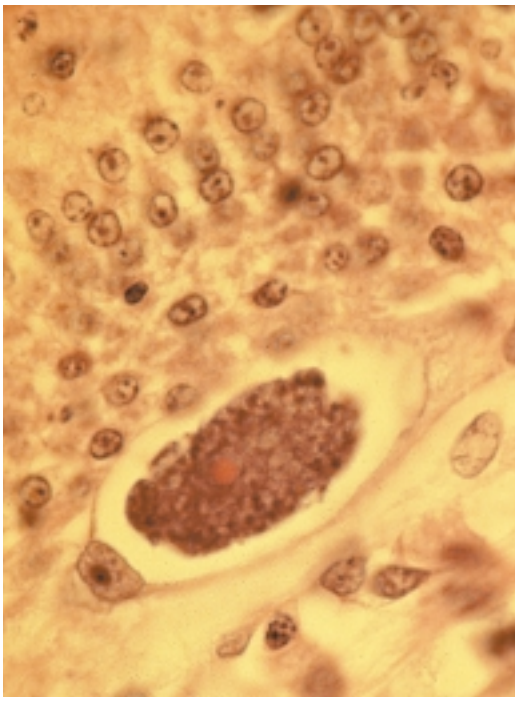
It is thus possible to think that some of the drugs, especially the ionophores, have for many years been acting in concert with background coccidial infection to function as "surrogate vaccines" by maintaining low levels (trickle doses) of infection that have immunised the hosts in the absence of disease.

New Control Strategies

Over 20 years ago, it became clear to many scientists that the rich genetic diversity of coccidia would require introduction of new control strategies if the parasites were to be controlled effectively in the long term. In other words, the almost blanket use of chemotherapy would not be adequate.

Immunoprophylaxis — the prevention of disease by utilizing natural immunity — largely remained neglected, although progress was made in the mid-1970s and throughout the 1980s on the selection of attenuated parasites that would provide the basis of a new generation of live vaccines.

The use of small numbers of normal, "wild-type" parasites (e.g., those recovered from the field) as vaccine components can be very successful if the delivery system is optimised so that most or all chickens within a flock ingest vaccinal oocysts around the same time. Unfortunately, failure to achieve uniform administration could result in heavy infections in non-vaccinated birds that were exposed to large numbers of oocysts produced by vaccinal oocysts as they recycle through the flock. Thus, the first-generation live vaccines were very effective at generating protective immunity in the host, but they had a comparatively restricted window of safety.



Eimeria brunetti

'Precocious' Lines

One objective of the search for new vaccine candidates was to derive "modified" parasites that would be protective but offer a greater margin for safety. It was anticipated that such candidates would therefore be eminently suitable for use in broiler production, where a larger margin of safety is required due to high stocking density and the precise economic production targets that are sought. The so-called "precocious" lines of *Eimeria spp.* fit the bill exactly and provided an ideal combination of:

• Potent immunogenicity (immunising the chicken as effectively as wild-type strains)

• Attenuation of virulence

• Reproduction that enables them to be used as "one-administration" vaccines

Species for a Broiler Vaccine

Of the seven species of avian coccidia, those encountered most frequently in broiler chickens worldwide are the pathogenic species *E. acervulina*, *E. maxima* and *E. tenella*. These three species will therefore form the basis of any live vaccine.

Eimeria brunetti and *E. necatrix* are highly pathogenic, but they tend to be found in older birds and are uncommon in broilers. Conversely, *E. praecox* is regarded as relatively benign and not a significant contributor to the general picture of coccidiosis, even though it is common in broilers.

For European flocks, *E. mitis* must be considered. It is significantly pathogenic but infections with this species are not revealed by the appearance of gross lesions that can be assessed by visual inspection with the naked eye. The contribution of *E. mitis* to subclinical coccidiosis has almost certainly been underestimated.

Drug-Sensitive Strains

It seems entirely logical that live coccidiosis vaccines will not be used concurrently with anticoccidial drugs and that each approach will be regarded as totally sufficient.

Since live vaccines will be used alone, the choice of drug-sensitive strains of *Eimeria* as their basis will be advantageous. For example, the use of such a product instead of anticoccidial drugs will introduce drug-sensitive oocysts into the environment and the incidence of drug-resistant strains will be expected to fall as they become diluted out.

Methods of administering coccidiosis vaccines to ensure more uniform application also have been developed.

Necrotic Enteritis

It is clear that both vaccines and anticoccidial drugs can achieve excellent coccidiosis control. Both options also have strengths and weaknesses.

For example, the activity of the antibiotic ionophores includes antibacterial effects; there is a perception by some within the poultry industry that with vaccination, the incidence of necrotic enteritis (NE) will rise, since vaccines will not have similar controlling effects of *Clostridium perfringens*. Interestingly, some of the first comprehensive data describing the use of live vaccines in broilers revealed more cases of NE in medicated control flocks.

A better understanding of the epidemiology of NE is most definitely required; the multiple factors that underpin cases of NE and any relationship between attenuated and/or wild-type coccidial parasites and *Clostridium* needs to be determined in the context of modern poultry practices and nutrition. (See article, page 18.)

Conclusion

Safe and effective vaccines based on precocious lines and improved methods of vaccine administration are available. There is also growing concern over the use of feed additives in poultry and increased demand for "greener" poultry production methods. These factors have led to an increasing interest in the worldwide availability of vaccines for use in broiler chickens.

Whatever lies ahead for the control of coccidiosis, it is beyond doubt that coccidia cannot go about their lifestyle of parasitism without the host declaring immunological war. Harnessing that rapid immune response can provide producers with state-of-the-art coccidiosis control and vaccination promises to be a powerful tool for the poultry industry well into the future.

Small birds *continued from page 5*

ble to ionophore programs even when flocks are processed at 40 days or less," Newman says.

Brazil Experience

While approximately 70% of the 3 billion broilers produced in Brazil each year are raised for 42 to 49 days, or to weights of 4.4 lbs to 7.04 lbs (2.2 kg to 3.2 kg), a significant number are processed at lighter weights.

For starters, some Brazilian poultry companies raise females for 34 days to 3.3 lbs (1.5 kg) for export to Middle Eastern countries. Customers in that part of the world purchase whole chickens for individual consumption.

In some parts of Brazil, birds are processed at 28 to 30 days of age when they weigh 3.2 lbs to 3.4 lbs (1.45 kg to 1.55 kg).

There is also a special market in that country for even smaller birds. About 5 million annually are processed under 3 lbs (1.36 kg). Routinely found on the menus of Italian restaurants in Brazil, they are known by a special name — "galeto" in Portuguese — which means "little chicken." The principal Brazilian producer of these birds is a company called Minuano, and the firm markets galeto under the trademark "Minu."

About 50% of Brazilian birds raised to 3.3 lbs (1.5 kg.) and smaller, or some 2.5 million birds per year, are vaccinated for coccidiosis, according to Dr. Vilson Simon, director of AviSui, the poultry and swine division at Coopers Brazil, a Schering-Plough Animal Health subsidiary.

"I've never seen any outbreaks of coccidiosis in these smaller vaccinated birds," Simon reports.

Proper nutrition is the key to making it work, Simon says. "We have developed a special ration for vaccinated birds that includes increased amounts of protein, vitamins A and E, and other micronutrients. This diet helps keep weight gain on target during the first 3 weeks of age when vaccine reactions peak, reducing concerns about compensatory gain at the end of the feeding period," he explains.

"If you practice good flock management but offer these small birds a poor meal, it's likely you'll get poor results," Simon emphasizes.

Positive Results in U.S.

In September 2000, an independent U.S. poultry company reported its experiences with small bird vaccination at a special CocciForum Symposium in Colorado. According to the firm's presentation, chickens raised to 4.2 lbs in 41 days exhibited no loss of performance based on weight, feed conversion and settlement cost for the first 2 weeks on live vaccine compared to the 2 previous weeks on the standard coccidiostat program.

For a copy of the CocciForum/Durango proceedings, which includes the U.S. company's coccidiosis vaccine experience and other related information, send your name and address toS chering-Plough Animal Health.
Fax: 908-629-3206
phyllis.middleton@spcorp.com

Simon: 'I've never seen any outbreaks of coccidiosis in smaller vaccinated birds.'

Townsends *continued from page 7*

Kohler: 'It's more economical to vaccinate than it is to add coccidiostats…'

used in Coccivac-B helps hatcheries monitor vaccine coverage. "It is believed that the chicks preen and ingest the vaccine orally," Phillips says.

Adds Helms, "With the spray cabinet, chicks are exposed to coccidiosis at an early age, so I am confident that immunity is established uniformly."

Townsends vaccinates for coccidiosis 4 days a week, and the 6-hour process to handle some 237,500 birds normally begins at 4:30 am.

The spray cabinet is checked several times during each of these four vaccinating cycles to make sure the system is administering the vaccine at the proper rate, which is 21 ml per box of 100 chicks.

"With our nozzle tips, we maintain a spray pattern from side to side and end to end inside the crates to make sure that the birds are totally covered," Kohler says.

Moreover, the spray cabinet is checked thoroughly once a week for routine maintenance and air pressure calibration.

Right Tool, Wrong Approach

There are no negative results associated with a properly designed and implemented coccidiosis vaccine program, Kohler asserts. But he is quick to point out that mismanagement can have a major impact on the success of the program.

"It's critical to use the vaccine at full dose," Kohler explains. "I know some companies that have tried cutting the recommended dose, but that plan just won't work. You have to administer one full dose for each bird to get optimum results."

"If you use any less than a full dose for each bird, you won't get optimum results and you'll create problems that will come back and haunt you," Kohler emphasizes. "Cutting the dose results in hit-and-miss vaccine takes, and you'll get some coccidiosis breaks you would not have gotten if you had followed the manufacturer's recommended protocol."

Producer panic can be another major hurdle to vaccination program success, Kohler adds. Some companies will vaccinate chicks correctly, but as soon as they see the birds exhibit a reaction such as lesions, they hit them with an anticoccidial, he observes.

"That knocks out the immunity the vaccine provides," Kohler says. "If producers follow the manufacturer's directions and just let nature take its course, the vaccine works like a charm."

Enteritis *continued from page 19*

and F.J. Hoerr of Auburn University wrote in a recent article.[1]

If a flock has experienced diseases such as necrotic enteritis, "the litter should automatically be cleaned out completely before any new flock is brought onto the premises," they report.

• **Check the litter.** Field observations indicate that high litter moisture encourages necrotic enteritis, according to Newman. Use an absorbent litter material such as wood shavings or rice hulls and maintain litter depth of at least 3 inches. "The best way to control litter moisture is to ventilate, ventilate, *ventilate*," she adds.

If the litter is found to be alkaline, which can result from applying lime, it should be treated to adjust the pH Cherry adds, "Changing the top of the litter with litter acidifiers makes the environment less suitable for bacterial growth."

• **Control access to bacteria.** According to Newman, infection occurs when bacterial numbers overwhelm the flock's ability to resist infection.

One of the biggest factors in bacterial access is litter picking.

"Growers should closely monitor feed availability to avoid litter picking," says Newman. "Frequent disinfection of water systems is also important."

• **Watch down time.** "Producers using intense management, including crowding birds and short down times of less than 12 days between flocks, are asking for trouble whether they're using an antibiotic or vaccination program," says Bushong. He recommends a minimum of 14 days down time.

1. *Poultry Digest,* August/September, 1999.

Chapman *continued from page 21*

came his way from the UA Dale Bumpers College of Agricultural, Food and Life Sciences.

"I love my work and I wouldn't change my career for anything," Chapman emphasizes. "Even though my primary responsibility is research, the most satisfying part of my appointment is teaching. Being involved with young people is the biggest advantage of the job."

Chapman contributes to an introductory animal science course for undergraduates, and also teaches a graduate course in poultry diseases, including coccidiosis, of course.

"David Chapman's ideas relative to coccidiosis control are extremely innovative and definitely ahead of their time," Danforth adds.

"It will take a while to educate producers and everyone involved in the industry that his recommendations are critical to flock health and profitability. But David is taking the lead in that regard and undoubtedly the poultry industry's ability to control coccidiosis in the years ahead will depend on his work."

Salmonella *continued from page 23*

"These are complex concepts because researchers still have some doubts about the mechanisms whereby beneficial bacterial microflora inhibit pathogens like *Salmonellae*," Andreatti Filho emphasizes.

"But it is already known that probiotics teamed with vaccines can help to reduce the use of veterinary pharmaceuticals in broilers. With proper protocols, these management tools promote good performance in broilers, while also reducing *Salmonellae*."

The results of the work of Andreatti Filho and his colleagues were highlighted in a paper entitled "The effect of coccidiosis vaccine on ***Salmonella enteritidis*** *colonization in broiler chicks inoculated with anaerobic cecal microflora," which was published in* ***Arquivo Brasileiro de Medicina Veterinária e Zootecnia*** *51(4), August, 1999, 311-361.*

COCCI FORUM

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Phillips Named Director of SPAH Technical Services

Schering-Plough Animal Health has named Rick Phillips, DVM, director of global poultry technical services. He replaces Michael Schwartz, DVM, who is retiring in May after 36 years with the company.

In his new role, Phillips will be responsible for managing global technical services programs to support the company's expanding poultry product line, which includes Coccivac and Paracox, the world's leading coccidiosis vaccines.

Phillips joined Schering-Plough Animal Health in May 2001 as poultry technical services manager. Earlier in his career, he held various technical services and operations positions for Foster Farms, Delhi, Calif., and Perdue Farms, Salisbury, Md.

Phillips has a DVM from Louisiana State University and a Masters in Avian Medicine from the University of Georgia.

Fitz-Coy to Focus on Coccidiosis

Dr. Steve Fitz-Coy, known throughout the poultry industry for his expertise in coccidiosis, has joined the technical services team of Schering-Plough Animal Health.

Fitz-Coy, who has a Ph.D. in poultry pathology and parasitology from Auburn University, comes to Schering-Plough with more than 20 years of industry experience. Most recently, he was a technical service representative for another pharmaceutical company with a line of coccidiostats.

Fitz-Coy has co-authored more than 30 abstracts and papers on coccidiosis management in poultry. In his new position, Fitz-Coy will provide technical support for Coccivac, Paracox and Clinacox (diclazuril).

Worth Repeating

"It's like recruiting for a basketball or a football program at a major university. If you have a reputation for winning, it's a lot easier to attract good people to your program. If you are the best, you'll attract the best."

Michael Schwartz, DVM, retiring director of SPAH poultry technical services, on what it takes to build a winning team in a poultry organization.

EU Bans Six Coccidiostats

A changing regulatory environment in Europe may steer even more poultry producers in the direction of coccidiosis vaccination.

The EU Agriculture Council Ministers recently voted to ban the anticoccidials amprolium, amprolium/ethopabate, dimetridazole, metichlorpindol, metichlorpindol/methylbenzoquate and nicarbazin.

These products were in the ongoing review of existing approvals, but according to published reports, the manufacturers had not produced the required data in time.

Let Us Spray

The new hatchery spray claim in Europe for Paracox-5 has attracted more interest in coccidiosis vaccination, but as in other markets, poultry companies must first install special spray cabinets at their hatcheries to administer the vaccine.

"We presently have Spraycox units in Spain, France, Portugal, Greece and England," says Paul Townsend, Schering-Plough engineer and poultry equipment specialist who's been modifying the cabinet to meet the needs of the EU market.

Coccivac-B Approved in Chile

Coccivac-B, the leading coccidiosis vaccine for broilers in Latin America, was recently approved for use in Chile. Equipment specialists from Schering-Plough Animal Health are now training leading poultry producers to use the Spraycox spray cabinet, which showers day-old chicks with the vaccine.

Coccivac-B, a live oocyst vaccine isolate from chickens and prepared from anticoccidial-sensitive strains of *Eimeria acervulina*, *E. mivati*, *E. maxima* and *E. tenella*, is already used by major poultry producers in Argentina, Brazil, Costa Rica, Mexico and Venezuela.

Brazilian Poultry Experts Tour U.S. Farms to Gain Insights on Coccidiosis Vaccination

Brazilian poultry specialists recently toured major U.S. companies using coccidiosis vaccination. Seven of the top 10 U.S. integrators are now vaccinating for coccidiosis.

Eight veterinarians, nutritionists and production managers from leading poultry companies in Brazil visited the United States recently to learn more about hatchery spray administration of coccidiosis vaccine.

Alter attending a technical briefing in Atlanta hosted by Schering-Plough Animal Health, the specialists were divided into three groups to tour poultry operations using Coccivac-B — Sanderson Farms and Peco Farms in Mississippi, Gold Kist and Wayne Farms in Alabama, and Gold Kist and Pilgrim's Pride in North Carolina.

"They enjoyed the visits because they could see the success of coccidiosis vaccination in the United States and exchange information with the American companies," says Dr. Fabio Jose Paganini of Schering-Plough's Coopers Brazil subsidiary.

The group later reconvened near Miami to discuss their findings and meet with Raul Kohan, president of Schering-Plough Animal Health.

Clinacox OK for US Turkeys

The U.S. Food and Drug Administration has approved Clinacox (diclazuril) for use in the feed of growing turkeys.

Clinacox — a synthetic coccidiostat used successfully by the U.S. broiler industry for nearly 2 years — gives turkey growers a new-generation synthetic coccidiostat from a chemical family not previously used in the United States for coccidiosis prevention or control, according to Dr. Lanny Howell, a technical service veterinarian for Schering-Plough Animal Health.

"The active ingredient, diclazuril, produces a 'cidal' effect on the major species of *Eimeria* that are pathogenic to turkeys — specifically *E. adenoeides*, *E. gallopavonis* and *E. meleagrimitis*," he says.

Since being introduced to the U.S. broiler industry in early 2000, Clinacox has proved to be highly effective for cleaning up coccidiosis in problem flocks and reducing or eliminating subclinical challenge. Field trials and customer experience have shown that broiler flocks treated with Clinacox average significant gains in feed conversion and energy efficiency.

"We expect to see similar results in turkeys," Howell says, adding that Schering-Plough Animal Health is pursuing combination clearances with the feed antibiotics used in turkeys.

To preserve the high efficacy of this versatile and safe coccidiostat, Howell strongly recommends limiting the product's usage to one cycle and then rotating to a coccidiosis vaccine such as Coccivac-T, which provides lifetime protection, or to another type of anticoccidial.

Paracox-5 Launched at Tel Aviv Conference

More than 120 independent and government veterinarians as well as growers and nutritionists attended a seminar in Tel Aviv, Israel, for the official launch of Paracox-5.

Dr. Martin Shirley of the U.K.'s Institute for Animal Health, who was involved in the product's development, headlined the conference with a presentation on the evolution of coccidiosis vaccines. (See Shirley's article, page 24.)

Schering-Plough's Dr. Thierry Martine, poultry manager for Africa-Middle East Operations, followed with a summary of data from trials conducted in Europe and Israel. He also reviewed the product's outstanding first-year performance in Israel.

Martine and Shirley

Rafael Campos Rodriguez, a Schering-Plough consultant from Spain, talked about using Paracox-5 to improve flexibility in feeding programs.

Coccivac®-B

Anticoccidial protection

Only vaccine approved for broiler spray application at day of age

- One dose confers immunity for the life of the bird
- Replaces oocysts resistant to drugs
- Doesn't leave residue in the carcass
- No risk of side effects
- Weight gain and feed conversion equal or superior to coccidiostat programs
- Sophisticated spray system (Spraycox™) developed especially for vaccination with Coccivac-B

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