Keeping coccidiosis manageable

Veterinarian Maarten de Gussem looks for signs of coccidiosis in a broiler flock

Coccidiosis continues to be the most frequently diagnosed disease in poultry. In fact coccidia are present in every poultry house in the world. All commercial poultry, at some time in their life, will become infected with coccidia. Making it the number one disease issue among veterinarians.

By Greg Mathis

Sherlock Holmes stated that once you have eliminated the impossible, whatever remains, however improbable, must be the truth. Unfortunately coccidiosis often fits this statement. Examples of impossible or improbable are that vaccines do not cycle as expected, show immunity to the most immunogenic species, *E. maxima*, immunity is often delayed and causes the most problems, or even when not used for long periods of time drug resistance persists. We do have a number of truths and coccidiosis if not always totally controlled can at least be managed.

High reproductive capacity

Coccidia are protozoan (*Eimeria spp*) parasites that infect the intestine or caeca of poultry. The level and species of coccidia will vary with anticoccidial programmes, management, and bird age. Several factors enable coccidia to spread rapidly and infect large numbers of confinement reared birds. All of the *Eimeria spp* infecting poultry have a rapid, approximately 7 day, life cycle and a high reproductive capacity. One Eimeria oocyst (external infective stage) can produce tens of thousands of coccidial oocysts. In a poultry house where millions of oocysts are present it is easy to understand how quickly a clinical

parasitic problem can occur. An oocyst is highly resilient to environmental conditions, including normal disinfectants that have no deleterious effect.
Removing used litter, litter amendments, and fire flame treatment of floors can reduce oocyst levels. However, due to a high reproductive capacity, the house will become contaminated again before the end of the bird's production period. Strict cleaning can actually change the timing and severity of coccidiosis compared to built-up litter facilities.
Every country or region of the world has the same Eimeria species with very little strain variation. Eimeria maxima reportedly has the most strain variation however the basic physiology, immunogenicity, and fecundancy are basically the same for all species. S. H. Fitz-Coy reported that birds immunized with the coccidia vaccine, Coccivac-B, and independently challenged with 60 field coccidial isolates demonstrated substantial *E. acervulina, E. tenella* and *E. maxima* immunity, with 86% fully protected against the *E. maxima* isolates.

Three major species

Polymerase Chain Reaction (PCR) technology uses the amplification of species-specific DNA sequences to determine the species of Eimeria present in poultry litter. Many researchers including M. Jenkins USDA, ARS, using PCR technology have shown that most poultry facilities (barns/ houses) generally have the three major species, *E. acervulina, E. maxima* and *E. tenella* as well as a high prevalence of the minor species, such as *E. mitis* and *E. praecox*. Is this high prevalence due to just naturally occurring populations, increased incidence and level of anticoccidial drug resistance leading to reduced control for all species, or to increased use of vaccines that do not contain these species, thus no immunological protection to these species? What the consequences will be for increased incidence and higher numbers of these less pathogenic species is yet to be determined.

Figure 1: % Necrotic enteritis mortality with chickens challenged with various species of Eimeria and Clostridium prefringens.

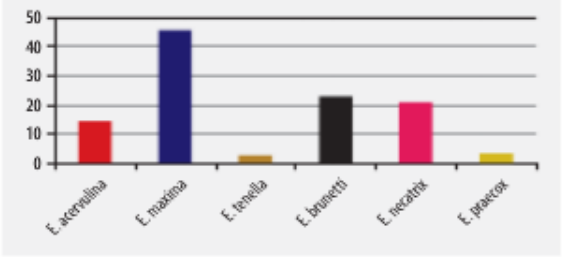
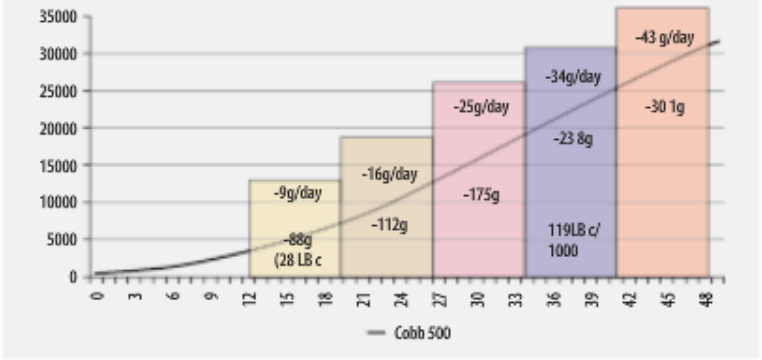


Figure 2 - Effects of coccidiosis along several points in the growth of broilers.



Most costly disease

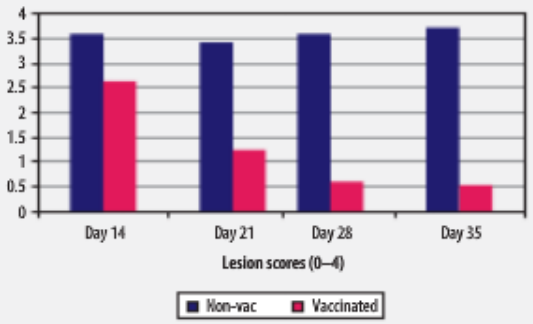
Coccidiosis coupled with associated enteric bacterial issues makes it the most costly disease facing the poultry industry. A recent survey of southeastern USA poultry veterinarians ranked disease issues with coccidiosis as number one and necrotic enteritis as number two followed by infectious bronchitis as a third. Intestinal damage by coccidiosis or other stressors (nutritional, environmental, etc.) enables Clostridium prefringens to proliferate and potentially cause necrotic enteritis. The most direct necrotic enteritis link is between Clostridium prefringens and coccidiosis with E. maxima being the leading cause *(Figure 2)*.
Mathis reproduced necrotic enteritis in chickens dosed with Clostridium prefringens and infected with *E. acervulina, E. maxima, E. necatrix*, or *E. brunetti (Figure 1)*. Thus controlling or managing coccidiosis and enteric bacterial infections are interrelated.
The goal of any anticoccidial program is to control severity of coccidiosis and also attempt to regulate when the primary damage will occur. The amount of damage is related to the species, amount, frequency and timing of exposure. Coccidiosis, even mild cases, have a negative impact on production with losses in feed conversion, weight gain, uniformity, pigmentation, and increased mortality. Teeter *(Figure 2)* examined the effects of coccidiosis along several points in the growth of broilers using a calorimetric chamber. He found the detrimental effects of coccidiosis to be more pronounced as birds mature, especially during the major growth period which occurs in the later phase of the grow-out. Birds with the same level of coccidiosis potentially could lose 9 g/day at 3 weeks of age vs 43 g/day at 6-7 weeks of age. A major advantage with coccidia vaccines is that coccidiosis cannot be totally avoided, thus it is advantageous to have a controlled level of coccidiosis early (such as with a vaccine) so the birds can develop an adequate immunity and to allow compensatory performance gain to reach it's fullest potential.

Two control programs

Eimeria are very immunogenic. With each cycle of coccidia in the host, immunological protection increases. The development of self-limiting immunity, which eventually protects a flock, is a very critical objective for a coccidiosis control program, whether vaccination or an anticoccidial drug program. Today poultry coccidiosis is controlled by the use of prophylactic feeding of anticoccidial drugs or vaccinating with live coccidial vaccines. Both types of programs rely on immunity development. In order to predict coccidiosis control and immunity development, performance and related oocysts litter/fecal numbers are valuable tools. *Figure 3* shows epidemiology (using oocyst numbers) of various anticoccidial programs.
Anticoccidials are broadly divided into synthetic (or chemical) and ionophores.

Fully sensitive chemical drugs limit oocysts shedding and related immunity development. The lack of full immunity once the chemical is removed influences subsequent degree and timing of coccidia development. Ionophores and partially resistant chemicals work similarly with partial direct control and regulated immunity development. Both of these traits allow some oocysts to be shed over the course of the growout with accompanying immunity development. Generally, oocysts shedding with this type of programme increases with a peak approximately at day 28-35. However, Chapman demonstrated that full immunity to most anticoccidial drugs take at least 6-7 weeks. Due to the increasing demand for drug-free birds and concerns of resistance issues with anticoccidials, the use of coccidiosis vaccination has grown tremendously in the last few years. The only method to produce a truly drug-free bird is through the use of coccidia vaccination. Vaccination programmes use live oocysts which are administered using a hatchery spray or gel, a gel puck placed into the hatchery box, or in-ovo dosing. These methods provide a prescribed amount of oocysts at an early age enabling immunity development to progress rapidly but still at a desired rate. A significant amount of immunological protection develops by 14 days of age, allowing birds to withstand a substantial challenge by 21 to 28 days of age *(Table 1)*. Coccidial vaccines are of two types; non-attenuated (not altered) and attenuated. All vaccines contain at least *E. acervulina*, *E. maxima*, and *E. tenella*. Some contain *E. mivati*, *E. necatrix*, *E. brunetti*, and/or *E. mitis*, and possibly more than one strain of *E. maxima*. Non-attenuated vaccinated broilers' oocysts shedding starts with an early day 7 peak, a major peak during days 18-28, and then a decline. Attenuation of the coccidia causes the attenuated vaccinated broilers to generally start oocysts shedding approximately a day earlier, with a lower oocysts shedding peak, and extends longer than non-attenuated vaccinated broilers. Many other factors influence oocysts shedding including management, duration of drug programme, breed, vaccine condition and application. To sustain good coccidiosis management all programmes and influences need to be considered.

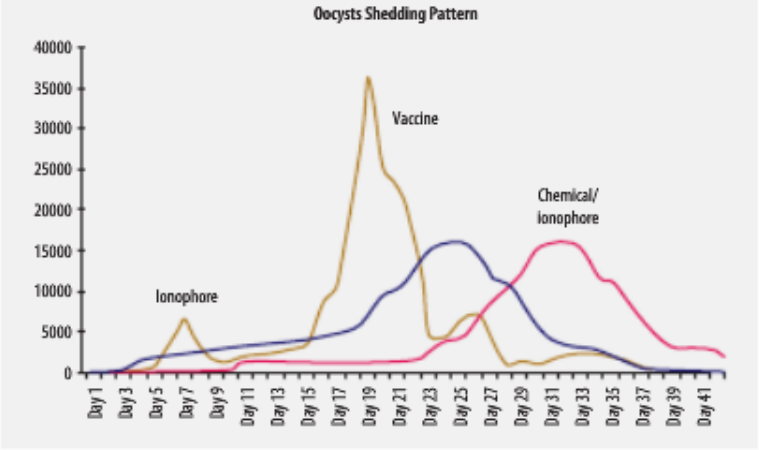
Table 1 - With a coccidial vaccine, as immunity develops, protection (lesion score reduction) increases.



Drug resistance problem

The major concern with anticoccidial drugs is development of resistance. Resistance to some degree has developed to all drugs. Rotation and resting (not using for extended periods of time) slows resistance development. However, with many of these drugs once resistance has developed it is very persistent/stable and years of non-use are needed to see a significant change. Anticoccidial sensitivity of coccidia isolated from poultry houses can be determined by Anticoccidial Sensitivity Tests. ASTs are very useful in attempting to predict the control programme that will have the most useful/ sensitive drugs. Some coccidial vaccines are comprised of drug sensitive strains. Vaccinating with vaccines that contain sensitive strains can potentially shift the coccidia population from a resistant to a more sensitive population. Coccidia isolated from three poultry complexes (eight farms each) were highly resistant to the drug Clinacox. After vaccinating with the coccidia vaccine, Coccivac-B, the coccidia were re-isolated. A major percentage of coccidia were now sensitive, with one complex's coccidia isolates (all eight farms) were 100% sensitive to Clinacox. This is not a permanent change. However, often performance and profits in production are improved with drugs after using a vaccine composed of drug sensitive coccidia strains.

Figure 3 - Feacal oocysts shedding pattern associated with various anticoccidial programmes.



Knowing what to manage

Even though coccidiosis always occurs, it can be managed. Using anticoccidial sensitivity tests to determine the level of resistance will provide information on which drug has the best potential for usefulness.

Key factors for drug usage are efficacy, sensitivity, timing of infection, and if producing antibiotic free birds. If managed properly, vaccination programmes can equal effectiveness and performance to a drug programme. Key factors of vaccination are application, vaccine storage, and farm management. Using the most effective drug programme, including utilising immunity and vaccination programmes will provide successful coccidiosis management. **WP**

References available upon request.