PathKinex™ Update: Coccidia Explained

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Coccidia are opportunistic intracellular protozoan parasites that can cause diarrhea. Found in the gastrointestinal tract, coccidia damage the gut wall of the host, resulting in nutrient malabsorption, dehydration, and blood loss; they can also make the host susceptible to secondary infections. Coccidia produce protective capsules called oocysts which, once sporulated, become infective and can survive in the environment for long periods of time (Images 1 and 2). This infection is called coccidiosis. Coccidia can infect a wide variety of animals, including humans, birds, rabbits, dogs, cats, goats, poultry, cattle, and swine. The genera *Eimeria* and *Isospora* contain many species that infect a range of hosts, and almost all species are host-specific. In production animals specifically,

infection can have serious economic consequences and often occurs through oral ingestion of oocysts from the environment.
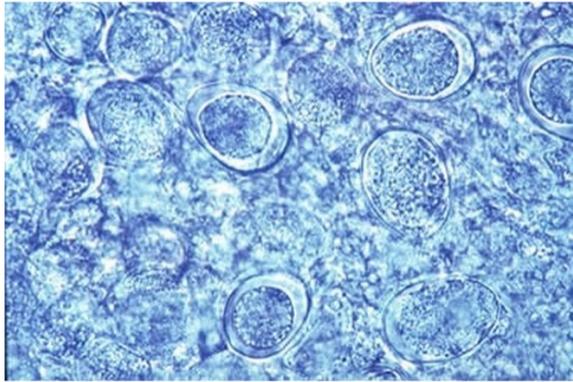

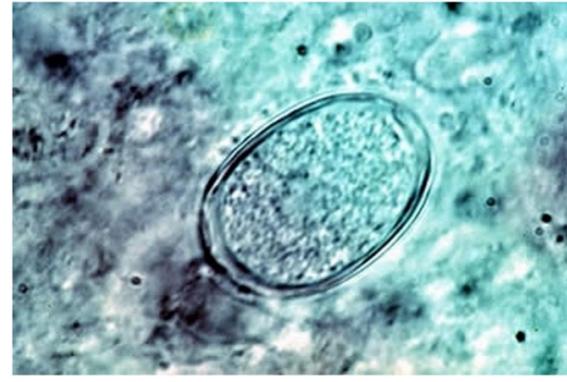**Image 1.** *Eimeria brunetti*, oocysts, poultry.

Image 2. *Eimeria maxima*, oocyst.

Both images courtesy of Dr. Jean Sander.[2]

Coccidia Infection

Coccidiosis is of greatest concern in poultry, but it also impacts ruminants and swine with subclinical infections, accounting for significant losses across all animal species in the production industry. Coccidia are almost universally present in poultry production systems. *Eimeria* spp. are the most common, with *Eimeria maxima* of greatest concern for poultry producers due to its known relationship with *Clostridium* and necrotic enteritis. However, the species *Eimeria necatrix* and *Eimeria tenella* are the most pathogenic on their own.[1] Common signs of infection in poultry include droopiness, depression, mucous and blood in the droppings, and loss of appetite. Coccidiosis can cause reduced growth rates, poor feed conversion, and reduced egg production and eggshell quality.

Eimeria spp. are also responsible for coccidiosis in cattle, with more than 20 *Eimeria* spp. identified worldwide. Bovine clinical infections typically occur between about one to two months of age and one year of age, particularly when weather conditions are moist and warm. Most infected calves show no clinical signs and appear healthy, although they are shedding oocysts in their feces. However, severe symptom-presenting cases are associated with loss of appetite, lethargy, diarrhea, abdominal discomfort, reduced growth rate, and, potentially, death.

In swine, the causative agent of coccidiosis is most often *Isospora suis*, and infection occurs most commonly in five- to fifteen-day-old piglets. Coccidia can be contracted from other piglets or the environment in contaminated farrowing and rearing housing. Infected piglets display diarrhea and stunted growth, and mortality rates can be up to 20%. In older pigs, infection is usually mild, mostly presenting as diarrhea, but can still result in stunted growth.

Microbial coinfection is common when coccidia are present. In poultry, it is well known that coccidiosis can open the door to necrotic enteritis associated with *C. perfringens*, but little is understood about the association of coccidia with other bacterial pathogens.

Microbial Discovery Group's PathKinex™ meta-analyses provided supporting data to what is widely accepted in the field:

- *Eimeria* species in poultry localize to different sections of the animal; specifically, *E. tenella* is known to invade the cecum. We found that *E. coli*, *Campylobacter jejuni*, and *Enterococcus cecorum* virulence genes were elevated in the cecum when *Eimeria tenella* was present.

- *E. maxima* invades the ileum of birds. In ileum samples, we saw increased levels of *C. perfringens*, *Campylobacter jejuni*, and *Enterococcus cecorum* genes when *Eimeria maxima* was present. The elevation of *C. perfringens* in the ileum when *Eimeria maxima* was detected may come as no surprise to those familiar with necrotic enteritis in broilers. *Eimeria* damages the intestinal lining, creating a perfect niche for clostridial overgrowth.

These findings add another dimension to our understanding. Not only are there complex interactions between pathogens occurring in the gut that may promote elevation of opportunistic microorganisms, but this interaction may also be specific to certain sections of the gastrointestinal tract.

Similarly, in dairy, we found that when mature cows were positive for coccidia, they also harbored higher quantities of *E. coli* and *C. perfringens*, suggesting the same opportunistic approach of these pathogen species when coccidia are present.

Prevention and Control

An integrated approach is often taken for prevention and control of coccidia. Environmental management practices alone, such as maintaining good hygiene, will often not control oocyst levels in the environment. Therefore, coccidiostats, antiprotozoal agents that act upon coccidia parasites, are used for prevention at

low doses and are also used when infections are present. The most common control method is live attenuated anticoccidial vaccines, which contain parasites of artificially reduced virulence, and these have had good success. Despite these available tools, coccidiosis remains a costly disease across all sectors, with current approaches leaving gaps in control and management. Animals with clinical signs of disease can benefit from supportive treatments like diet changes or feed additives to help control opportunistic bacteria, improve gastrointestinal health, preserve gut integrity, and reduce damage and disease complexes caused by coccidia.

Current Methods for Detection of Coccidia and Exciting PathKinex™ Advancements

Currently, diagnosis of coccidiosis is often reached based on history, clinical signs, fecal flotation, and lesions at necropsy. These methods can be time-consuming and do not easily lend themselves to large-scale analyses. In existing scientific literature, there are some quantitative real-time polymerase chain reaction (qPCR) methods to quantify *Eimeria* species but very few to quantify *Isospora suis*, the dominant species in swine.

At United Animal Health and Microbial Discovery Group, we have made advancements in the ability to detect *Eimeria*, including the addition of *Eimeria bovis* to our PathKinex™ microbial surveillance platform in 2018, and common poultry species like *E. maxima*, *E. tenella*, and *E. acervulina* in 2019. This year, our team is thrilled to announce the development of a new assay targeting *Isospora suis*. This assay, now available as part of our swine PathKinex™ panel, was developed in-house and validated in part using known coccidia-positive swine samples received through a collaborative project with Iowa State University. This is an exciting advancement that will provide new insights into coccidial coinfections in swine and allow us to monitor the impact of interventions in decoupling these coinfections.

For more details on coinfections, check out our "Microbial Cross Species Insights" presentation. Slides 25–32 focus on how coccidia are involved in coinfection.

To learn more about how ProVent®ECL Plus can reduce post-weaning mortality when used on top of coccidia treatment, refer to our "ProVent® ECL 301 Summary" presentation, specifically slides 27–30.

About the Author:

Kaley Pederson is a Microbiologist III at Microbial Discovery Group. She is focused in further understanding swine host-microbe interactions through the application of large-scale microbial surveillance platforms, as well as characterization of novel microbial strains.

References:

1. Andrews, A. (2022). *Overview of coccidiosis in animals - digestive system*. Merck Veterinary Manual. https://www.merckvetmanual.com/digestive-system/coccidiosis/overview-of-coccidiosis-in-animals

2. Richard, G. (2023). *Coccidiosis in Poultry*. Merck Veterinary Manual. https://www.merckvetmanual.com/poultry/coccidiosis-in-poultry/coccidiosis-in-poultry#Clinical-Findings-and-Lesions_v3340078

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