

## FUTURE OF COCCIDIOSIS MANAGEMENT IN TURKEYS

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Coccidiosis is a disease that is caused by protozoan parasites that develop within the intestine of most domestic and wild animals and birds. Coccidia were recognized as parasites of turkeys in the United States as early as 1895. Seven species of coccidia infect turkeys. Four of these, *Eimeria meleagrimitis*, *E. adenoides*, *E. gallopavonis* and *E. meleagridis* are considered to be among the most pathogenic of the species and have been identified repeatedly in the major turkey producing areas of the world (Edgar et al., 1965; Marshall et al., 1997; Chapman 2006, 2008)<sup>1</sup>.

Each species invades and develops in a specific, defined area of the intestine. The parasitized area of the intestine increases with severe infections and some species develop along the entire length. Diagnosis and speciation are usually determined by location of the infection in the intestine, the appearance of the droppings or intestinal contents, and the presence, size and shape of the oocysts (Droual *et al.*, 1994). The potential for a marked increase in the incidence of coccidiosis in turkeys has occurred in recent years because of the rapid growth of the turkey industry and the movement No Antibiotics Ever (NAE) production methods. However, the efficacy of currently used anticoccidial medications and vaccines has controlled, to a large degree, clinical coccidiosis in the field.

Several types of protozoa are associated with enteric disease of turkeys. Protozoal enteritis can present with general signs, including dehydration, loss of appetite (off-feed), loose droppings and watery intestinal contents. Flagellated protozoa include *Cochlosoma*, *Tetratrichomonas*, *Histomonas* and *Hexamita*. Coccidia *Cryptosporidia* and *Eimeria* are non-flagellated protozoa of turkeys. *Cochlosoma* and *Hexamita* have recently been associated with enteritis, primarily in young turkeys, especially in the summer months. There are field reports of co-infections with *Cochlosoma* and *Tetratrichomonas*, or *Cochlosoma* and *Hexamita*, or flagellated protozoa and *Eimeria*. Diagnosis is confirmed by mucosal scrapings and microscopic examination at 400X magnification<sup>2</sup>.

“*E. edgari* is highly pathogenic in turkeys ...” new species of *Eimeria* can be found in about 6 of every 10 samples from commercial turkey flocks around the US, as well as in wild turkeys<sup>3</sup>. *E. edgari* was first confirmed by Parasitologist Dr. Fitz-Coy and since diagnosed by veterinarians across the country. This small-spherical coccidia, smaller than other turkey oocysts, is most predominant in the upper and mid-intestine. *E. edgari* is associated with enteritis, watery intestinal contents with focal areas of orange-tinged mucus in duodenum and jejunum, resulting in uneven bird sizes and mortality and flushing.

## COCCIDIOSIS MANAGEMENT

An effective coccidiosis control program in turkeys involves the use of anticoccidial medications and/or phytonutrients and/or live vaccines and the subsequent development of immunity. Coccidiosis increased from #13 to #6 ranking in a 2017 turkey industry survey<sup>4</sup> of 36 health issues, most likely reflecting the industry increasing raised without antibiotics (RWA) and no antibiotics ever (NAE) market. RWA and

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<sup>1</sup> Chapman HD. Coccidiosis in the turkey. *Avian Pathol.* 2008 Jun;37(3):205-23.

<sup>2</sup> Clark, Steven and J Barnes. Controlling *Cochlosoma* and other Protozoa in Turkeys. *World Poultry*, 2003.

<sup>3</sup> Steve Fitz-Coy, 2014. <https://www.ihc-poultry.com/pages.aspx?id=692> Accessed Oct 10, 2017.

<sup>4</sup> Clark, SR et. al.. Current Health and Industry Issues Facing the US Turkey Industry. Proceedings 121st Annual Meeting of the USAHA, San Diego, CA; Committee on Poultry and Other Avian Species. Pending Publication. Oct 17, 2017.

NAE programs do not permit the use of ionophore anticoccidials and many programs prohibit FDA approved chemical anticoccidials, so anticoccidial programs consist of alternatives or vaccination. An effective coccidiosis control program in turkeys involves the use of anticoccidial medications and/or phytonutrients (alternatives) and/or live vaccines and the subsequent development of immunity. Table summarizes the US turkey production coccidia control products (n=265.9 million head) and ionophores represent the majority, 55% of heads for an average use of 7.5 months during the 12-month survey period. Chemical anticoccidials account for 33% head and 4.5 months. Coccidia vaccination was limited to 7% head; the low incidence might be in part due to the restricted availability 2016-2017 of the only USDA approved commercial turkey coccidiosis live vaccine. Nutritional dietary supplementation with phytonutrients (alternatives) is becoming more popular, reported at 14% head, either via in-feed application or drinking water administration.

Anticoccidials are products used to combat coccidiosis in poultry. After the infective sporulated oocysts are ingested, the sporozoites invade the intestinal cells and then mature. The sporozoites mature through asexual and sexual stages. It is during the asexual stage that the coccidia are most damaging to the intestine, especially if left uncontrolled by an effective anticoccidial and a strong immune system. A number of medications have been approved for use against turkey coccidiosis and fall into different classes: **divalent ionophores** including lasalocid (Avatec®) and **monovalent ionophores** including monensin (Coban®) are most commonly used to stimulate immunity. **Synthetic** anticoccidials, such as zoalene (Zoamix®) or SDM+OMP (RofenAid®), may be used in rotation programs throughout the year, or a **shuttle program** in the same flock, with ionophores.

In commercial turkey production, an effective coccidiosis control program involves the rotation of these medications. A true **rotation program** means changing to solutions in a different product class, helping ensure that managing *Eimeria* species with different modes of action over time. Rotating among different classes of solutions, such as from a divalent ionophore to a synthetic anticoccidial, also is critical in order to avoid resistance and help secure the long-term viability of all coccidiosis management tools. Neglecting rotation can increase infection pressure over the longer term, and subclinical coccidial losses can be higher.

In commercial conditions, anticoccidials are supplemented in the feed starting at 1-day of age and are withdrawn when the birds are approximately 9 to 12 weeks of age. The producer then relies upon immunity developed during the first part of the grow-out to protect the birds after anticoccidials are withdrawn from the feed.

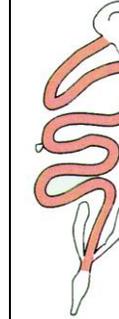
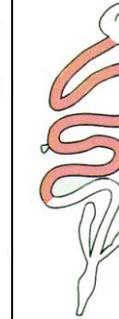
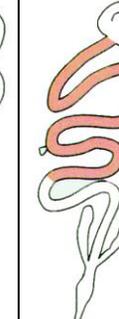
Immune-control of coccidiosis in turkeys is attractive because coccidia can elicit an immune response to infection, and the response elicited in 1-day of age poults can be only slightly less protective than that generated in older poults (Augustine, 1988). Coccidia **vaccines** are composed of virulent isolates of two to four turkey species of coccidia. Immucox® T coccidia vaccine by Ceva is the only approved vaccine in the USA. It has 2 wild-type turkey *Eimeria* species (*E. meleagritidis* and *E. adenoides*). Originally, the vaccines were administered in the drinking water, but other methods including spray cabinet, eye drop, and gel or other edible materials are being evaluated as delivery systems. Regardless of the method of vaccination, repeated exposure to the coccidia, which occurs as a result of recycling of the oocysts through the poults, is essential for the development of protective immunity.

Nutritional dietary supplementation with **phytonutrients** is becoming more popular, either via in-feed application or drinking water administration. Programs may utilize phytonutrients in addition to the current anticoccidial program, to potentiate the possible benefits. Some phytonutrients have purported activity against coccidia. Phytonutrients may be classified as, plant extracts (yucca, etc.), prebiotics (beta glucans, yeasts), essential oils (oregano, carvacrol, thymol, cinnamaldehyde, capsicum oleoresin, turmeric oleoresin).

## SUMMARY

Coccidiosis of turkeys is a problem, especially subclinical disease, and it is able to affect turkeys of all ages. Turkey coccidiosis can be successfully controlled by judicious use of anticoccidials and innovative uses of phytogetic compounds, yet it is difficult to diagnose. However, this disease may be diagnosed after evaluating other health factors, clinical signs, management factors, and identifying oocysts.

**Table 1. Diagnostic characteristics of *Eimeria* species in turkeys (Roche, 1995).<sup>5</sup>**

Characteristics	EIMERIA SPECIES						
	<i>E. adenoeides</i>	<i>E. gallopavonis</i>	<i>E. meleagrititis</i>	<i>E. dispersa</i>	<i>E. innocua</i>	<i>E. meleagridis</i>	<i>E. subrotunda</i>
 <p>Lesions Occasional lesions Coccidia, no lesions</p>							
<b>Location</b>	ceca, rectum	lower intestine, ceca, rectum	small intestine	small intestine	upper small intestine	lower small intestine, ceca, rectum	upper small intestine
<b>Macroscopic lesions</b>	liquid feces with mucus and flecks of blood, loose whitish cecal cores	edema, ulceration of mucosal ileum, yellow exudate, flecks of blood in feces	spotty congestion and petechiae from duodenum to ileum, dilation of jejunum, casts	cream-colored serosal surface, dilation of intestine, yellowish mucoid feces	none	cream-colored ceca, formation of caseous plug, few petechial hemorrhages	none
<b>Average length x width (mμ)</b>	25.6 x 16.6	27.1 x 17.2	19.2 x 16.3	26.1 x 21.0	22.4 x 20.9	22.4 x 18.1	21.8 x 19.8
<b>Length Width</b>	18.9 - 31.3 12.6 - 20.9	22.7 - 32.7 15.2 - 19.4	15.8 - 26.9 13.1 - 21.9	21.8 - 31.1 17.7 - 23.9	18.57 - 25.86 17.34 - 24.54	20.3 - 30.8 15.4 - 20.6	16.48 - 26.42 14.21 - 24.44
<b>Oocyst shape and index</b>	ellipsoidal	ellipsoidal	ovoid	broadly oval	subspherical	ellipsoidal	subspherical
<b>Length/width</b>	1.54	1.52	1.17	1.24	1.07	1.34	1.10
<b>Minimum sporulation (hrs.)</b>	24	15	18	35	<45	24	48
<b>Minimum prepatent period (hrs.)</b>	103	105	103	120	114	118	95
<b>Refractile body</b>	yes	yes	yes	no	no	yes	no
<b>Relative pathogenicity</b>	++++	++++	++++	+	none	none	none

<sup>5</sup> Adapted from Reid, W.M., P.L. Long and L.R. McDougald. 1984. Coccidiosis. M.S. Hofstad, H.J. Barnes, B.W. Caineck, W.M. Reid and H.W. Yoder Jr. (Eds.) Diseases of Poultry. 8th ed. Iowa State Univ. Press, Ames Iowa, U.S.A. p 692.

**Table 2.** Turkey health survey (August 2016 – August 2017) of professionals in US turkey production coccidia control programs (n=265.9 million head).<sup>6</sup>

<b>Program</b>	<b>How many months (average)</b>	<b>How many head (count divided by total survey count)?</b>
Ionophore	7.5	55%
Chemical	4.2	33%
Alternative (Phytonutrients)	4.0	14%
Vaccine	2.3	7%

**Table 3.** Eighteen (18) in-feed and eleven (11) in-water FDA approved medications for turkeys. ^ Not currently marketed. <sup>C</sup> As an aid in the prevention of leucocytozoonosis caused by *Leucocytozoon smithi*. <sup>G</sup> Includes label claim for improved weight, gain and feed conversion. ® All trademarks or trade names are property of their respective owners. \*CAUTION: Federal law restricts medicated feed containing this veterinary feed directive (VFD) drug to use by or on the order of a licensed veterinarian. \*Extralabel Drug Use (EDLU) is not permitted in feed. \*\*CAUTION: Federal (USA) law restricts this drug to use by or on the order of a licensed veterinarian. Species can vary, observe label indications. ® <sup>TM</sup> All trademarks or trade names are property of their respective owners. **Anticoccidials are in bold font.**

<b>VFD Medications* for Turkeys</b>	<b>Non VFD Medications for Turkeys</b>
Albamix (Novobiocin) <sup>^</sup>	Albac® (Bacitracin Zinc) <sup>^G</sup>
Aureomycin® (Chlortetracycline)	<b>Amprol® (Amprolium)</b>
ChlorMax® (Chlortetracycline)	<b>Avatec® (Lasalocid)</b>
Neo-Oxy® (Neomycin + Oxytetracycline)	BMD® (Bacitracin Methylene Disalicylate) <sup>G</sup>
Neo-Terramycin® (Neomycin + Oxytetracycline)	<b>Clinacox® (Diclazuril)<sup>^</sup></b>
Pennchlor® (Chlortetracycline)	<b>Coban® (Monensin)</b>
Pennox® (Oxytetracycline)	Coyden® (Clpidol) <sup>^C</sup>
Pharmastatin (Nystatin) <sup>^</sup>	Flavomycin® (Bambermycin) <sup>G</sup>
<b>RofenAid® (Sulfadimethoxine + Ormetoprim)<sup>^</sup></b>	Safe-Guard® (Fenbendazole)
Terramycin® (Oxytetracycline)	<b>Stenorol® (Halofuginone)<sup>^</sup></b>
	Topmax <sup>TM</sup> (Ractopamine) <sup>^</sup>
	<b>Zoamix® (Zoalene)</b>

<b>Prescription Medications** for Turkeys</b>	<b>Non Script Medications for Turkeys</b>
Aureomycin® Soluble (Chlortetracycline)	<b>Amprol (Amprolium)</b>
<b>Di-Methox® (Sulfadimethoxine)</b>	BMD® Soluble (Bacitracin Methylene Disalicylate)
Gallimycin® PFC (Erythromycin)	
Neo-Sol® (Neomycin)	
NeoMed® (Neomycin)	
Oxytet® Soluble (Oxytetracycline)	
PenAqua Sol-G® (Penicillin G Potassium)	
Pennchlor 64® (Chlortetracycline)	
Pennox 343® (Oxytetracycline)	

<sup>6</sup> Clark, SR et. al.. Current Health and Industry Issues Facing the US Turkey Industry. Proceedings 121st Annual Meeting of the USAHA, San Diego, CA; Committee on Poultry and Other Avian Species. Pending Publication. Oct 17, 2017.

<b>PoultrySulfa® (Sulfamerazine, Sulfamethazine, Sulfaquinoxaline)</b>
R-Pen® (Penicillin G Potassium)
TetraMed® 324 HCA (Tetracycline)
Tetroxy® HCA Soluble (Oxytetracycline)
Tet-Sol™ 324 Soluble (Tetracycline)
Tylan® Soluble (Tylosin Tartrate)
Tylovet® Soluble (Tylosin Tartrate)