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Efficacy of Nitarsone, Monensin or Nitarsone Followed by Monensin, in Female Turkeys in Litter Pens and Exposed to Coccidial (25 Days) and Cochlosomal (28 Days) Inoculations

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A preliminary study with Hybrid turkey poults was conducted in December, 2001-January, 2002 at Virginia Scientific Research, Inc. using a combined *Eimeria* spp and *Cochlosoma anatis* (8×10^5) oral dose at seven days of age resulted in excessive mortality (39.58% vs 5.73% in uninfected poults) so that valid conclusions could not be drawn about the effectiveness of separate treatments with dietary monensin (72 g/ton; 28.65% mortality) or nitarsone (170.3 g/ton; 48.44% mortality). See Table 1. The coccidial species administered at 5,000 oocysts per poult on day seven were *E. gallapavonis*, *E. adenoides*, and *E. meleagrimitis*. Elevated mortality at 14 days of age and seven days post exposure was atypical for a coccidial challenge of the low dosage used in this study, and the secondary Cochlosoma infection may have been responsible. The trial had to be terminated at 19 days due to severe mortality. Results of a successful subsequent 98-day turkey pen trial with a similar coccidial challenge at a later age, 25 days, as well as a milder cochlosomal challenge (2×10^5) at a later age, 28 days, are reported in this article.

Nitarsone (4-Nitrophenylarsonic acid; Histostat®, Alpharma, Inc.) is approved for use in the feed of chickens and turkeys at 0.01875% (170.3 g nitarsone/ton) as an aid in prevention of histomoniasis ("blackhead", a misnomer) caused by the protozoa *Histomonas meleagridis* (Skinner, 2000). Histomoniasis is characterized by cecal inflammation and large cheese like cecal cores, and sometimes liver mottling deep into the tissue. It may be associated with roundworm and cecal worm problems, enteritis, and/or coccidiosis, occasionally making the diseases difficult to distinguish (McDougald and Casey, 1982). Nitarsone is approved for use with bacitracin methylene disalicylate or zinc bacitracin (Skinner, 2000).

Cochlosoma anatis is a flagellated protozoan parasite of poultry, with oral inoculations of turkeys resulting in trophozoites being most numerous in jejunum and ileum but also observed in duodenum, ceca, colon, and feces. When 12 naive turkeys were placed on contaminated litter from infected turkeys, only one in 12 became infected. Experimentally, four of six bobwhite quail and one of eight chickens inoculated with trophozoites had detectable lesions. Trophozoites were observed only in the ilea of quail and only in the ceca of the positive chicken. Trophozoites collected from bobwhite quail and chickens remained infectious for turkeys (Lindsay *et al*., 1999).

Table 1: Results of preliminary pen trial on new litter with Hybrid turkey poults inoculated with both *Eimeria* spp and *Cochlosoma anatis* at seven days of age

Dietary Treatment[1]	Day 7 Inoculations	0 to 14 Day Mortality, %
Control (Uninoculated)	No	5.73 [c]
Control (Inoculated)	Yes	39.58 [ab]
+ Monensin (72 g/ton)	Yes	28.65 [b]
+ Nitarsone (170.3 g/ton)	Yes	48.44 [a]

[a - c] Means within a column and lacking a common superscript differ ($P < 0.05$). [1]There were six observations per treatment (32 poults started per replicate pen).

Some of the effects and symptoms of *Cochlosoma anatis* infection in various poultry species have been described in the scientific literature. Outbreaks of enteritis associated with an unusual flagellated protozoan (*Cochlosoma anatis*) occurred in six California turkey flocks during the summer of 1992. The flagellate attached to the intestinal mucosa by means of a sucker-like apparatus, and circular impressions of the sucker were created on the surface epithelium, Histological lesions were characterized by: 1) blunting and fusion of villi; 2) cellular in filtration of lamina propria with lymphocytes, plasma cells, histocytes, and heterophils; and 3) increased numbers of mitotic figures in crypt epithelium (Cooper *et al*., 1995).

Female Muscovy ducklings inoculated at day-old or for five consecutive days with 3×10^6 trophozoites, compared to uninoculated controls, did not differ in 22-day body weight, but had significantly greater intestinal crypt depth in duodenum, proximal jejunum, and ileum. Villus height and sucrase activities were increased in all sections of the small intestine. Inoculation reduced jejunal mucosal maltase and palatinase activities. No clinical signs were evident (Bollinger *et al*., 1996b). Ducklings, especially common golden eye (*Bucephala*

Table 2: Description of treatments in turkey pen trial (April-July, 2002)

Dietary Treatment[1]	Inoculations	Medication		
		0-42 d	42-84 d	84-98 d
Control (Unioculated)	No	None	None	None
Control (Inoculated)	Yes	None	None	None
+ Monensin	Yes	Monensin	Monensin	None
+ Nitarsone; Monensin	Yes	Nitarsone	Monensin	None

[1] There were six replicate pens of 32 poults initially per treatment, and 3 turkeys per pen were removed at six weeks of age for disease confirmation. Levels of addition were: monensin, 72 g/ton; nitarsone, 170.3 g/ton.

Table 3: Effects of dietary medications monensin or nitarsone on 98-day live performance of female turkeys in litter pens and without or with inoculations of coccidia (25 days) and cochlosoma (28 days), April-July, 2002

Dietary Treatment	Body Weight kg	Feed, kg/ BWt, kg	Mortality %	Feed Cost $/Turkey	Feed Cost $/kg Gain
Control (Unioculated)	6.392 [a]	2.279 [a]	3.45 [a]	2.490 [a]	0.3607 [a]
Control (Inoculated)	6.111 [b]	2.165 [b]	4.02 [a]	2.262 [b]	0.3437 [ab]
+ Monensin	6.190 [a]	2.074 [c]	3.45 [a]	2.222 [b]	0.3314 [c]
+ Nitarsone; Monensin	6.243 [a]	2.131 [b]	3.45 [a]	2.319 [b]	0.3430 [b]

[a - c] Means within a column and lacking a common superscript differ (P < 0.05).

Table 4: Wetness condition of droppings (excreta) and litter in a combined visual score 0 to 4 (normal; to very wet litter and abnormal droppings)

Dietary Treatment	Days of age				
	42	56	70	84	98
Control Uninoculated	0.67 [c]	1.17 [b]	1.33 [ab]	2.17 [a]	1.33 [a]
Control Inoculated	2.50 [a]	2.50 [a]	2.00 [a]	1.83 [a]	1.50 [a]
+ Monensin	2.17 [ab]	2.33 [a]	1.67 [ab]	1.17 [b]	1.17 [a]
+ Nitarsone; Monensin	1.17 [b]	1.17 [b]	1.17 [b]	1.17 [b]	1.17 [a]

[a - c] Means within a column and lacking a common superscript differ (P < 0.05).

clangula), experiencing poor weight gain and delayed development were reported from a waterfowl park during summer. Runting syndrome was first noticed between 5 and 10 days post-hatch in the brooding phase, and although ducklings appeared active and were feeding, they developed at a slower rate than other members of their clutch. Necropsies of affected ducklings revealed large numbers of the intestinal flagellate *Cochlosoma anatis* in both the small and large intestines. Inoculation of day-old Muscovy ducklings with feces containing large numbers of *C. anatis* resulted in poor weight gain and delayed tail-feather development compared to uninoculated control ducklings (Bollinger and Barker, 1996a).

A pen trial on new litter was conducted from April 4 to July 10, 2002 (98-days duration) to evaluate the effects of dietary monensin or nitarsone on live performance of female turkeys without or with *Eimeria* spp and *Cochlosoma anatis* inoculations. A description of the treatments is shown in Table 2. The poults had an average weight of 51.6 g or 0.111 lb at placement. Stocking density, assuming 29 poults per pen at six weeks of age, was 2.07 sq ft/bird (0.1923 sq m/bird). A five-phase feeding program was used: starter (0 - 21 d), grower 1 (21-42 d), grower 2 (42-64 d), finisher 1 (64-90 d), and finisher 2 (91-98 d). A mixture of field isolates of coccidia strains (*Eimeria gallapavonis*, *adenoides*, and *meleagrimitis*) contributing 5,000 oocysts per strain was administered orally per bird at 25 days of age. Intestinal mucosa material scraped from *Cochlosoma anatis* infected turkey poults was homogenized and diluted with sufficient phosphate buffered saline solution so that a 0.1 ml dose contained 2 x 10^5 organisms, and this liquid preparation was administered to each turkey in the challenge pens by oral gavage using a 1 mL syringe at 28 days of age.

In experimentally inoculated turkeys from the various inoculated treatments, intestinal scrapings were observed microscopically and found to be positive for both coccidia and Cochlosoma. No coccidia oocysts or Cochlosoma organisms were observed in the samples from the non-challenged turkeys. Intestinal samples in formalin were sent to Virginia Tech in Blacksburg for determination of Cochlosoma levels.

Phase feed prices per ton (unmedicated) were in US $: 166.25, 159.06, 150.00, 138.41, and 131.21. Coban (monensin) was $2.00/lb, inclusion rate 1.1 lb/ton, and total cost $2.20 extra per ton of feed. Histostat (nitarsone) was $8.25/lb, inclusion rate was 0.75 lb/ton, and total cost $ 6.19 extra per ton of feed.

Final (98-day) live performance results are presented in Table 3. A significant depression in body weight occurred due to inoculations with coccidia and Cochlosoma compared to uninoculated control, validating the disease model. Adding either monensin or nitarsone followed by monensin to turkey diets improved final body weight to statistical equivalence with the uninoculated control treatment. Each of the inoculated, medicated treatments improved feed conversion ratio compared to the uninoculated control (turkey weights were smaller), with monensin alone giving the best effect. Mortality was not affected by the disease and medication treatments (3.45 to 4.02%). The larger turkeys in the uninoculated control group had significantly higher feed expense per bird and per kg of weight gain than other treatments. Monensin supplementation gave the lowest feed cost per kg of weight gain.

The wetness condition of droppings and litter by subjective scores are given in Table 4. At 42, 56, 70, and 84 days of age, the scores were significantly lower for the nitarsone followed by monensin treatment group than for the inoculated control. Droppings and litter scores for the nitarsone followed by monensin group tended to be intermediate in value between the inoculated control and the monensin treatment at 42, 56, and 70 days of age, but the medicated treatments were identical for the 84 and 98 day measurements.

It was concluded that dietary monensin (72 g/ton) from 0 to 84 days of age can improve final weight, feed conversion ratio, and feed expense per kg of gain of coccidial and Cochlosoma infected turkeys compared to infected, unmedicated turkeys. The use of nitarsone for 42 days followed by monensin from 42 to 84 days can increase body weight in infected flocks.

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