

Administration of a Coccidiosis Vaccine to Day-Old Turkeys Via the Eye and Development of Immunity to *Eimeria* Species¹

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ABSTRACT Day-old turkey poults were given a live coccidiosis vaccine via the eye at the hatchery, and all poults produced oocysts in their droppings 7 d later. No oocysts were present in droppings of unvaccinated controls. The weight gain of vaccinated poults challenged at 3 wk of age with a mixture of three species

of *Eimeria* was lower than that of unchallenged poults, indicating that they were susceptible to infection. No significant difference in weight gain was found when poults were challenged at 6 wk, however, indicating that they had acquired immunity to the species used for challenge.

(Key words: coccidiosis vaccine, poult, *Eimeria*, intraocular injection, immunity)

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INTRODUCTION

Coccidiosis is an important disease of the intestinal tract of the turkey (Edgar, 1985). Control of the disease is achieved by providing anticoccidial drugs in the feed, but not all currently approved compounds are effective (Cabel *et al.*, 1991). An alternative to chemotherapy is the immunization of turkeys against coccidiosis, and a live vaccine² is available for this purpose. Immunization is possible because the species of *Eimeria* that parasitize the turkey can induce a protective immune response. Historically, the vaccine has been administered via the drinking water or by spraying directly on the feed, but recently application by eye spray at the hatchery has been recommended. Advantages of the eye spray method, compared with more traditional procedures for vaccinating poultry, may include reducing labor costs and providing a consistent and uniform dose of vaccine to individual birds. Although vaccination by eyespray has been practiced commercially, there have been no published studies demonstrating that it is possible to introduce oocysts of *Eimeria* via the eye, and no proof that infection introduced by this route can protect birds against challenge with *Eimeria* species. The eye has been used for many years as a route to vaccinate poultry against viral diseases such as Infectious bronchitis, Newcastle disease, and Marek's disease. The nasolacrimal duct provides a connection between the

conjunctival space around the eye and the nasal cavity, which in turn is connected to the oro-pharynx (Martin, 1985). It is conceivable that if oocysts are sprayed on the eye some enter the poult via the oral cavity. The present experiment was undertaken to demonstrate the validity of the eye route as a method for introducing oocysts and to investigate the ability of a live coccidiosis vaccine given in this manner to vaccinate poults against *Eimeria* species.

MATERIALS AND METHODS

Seventy-five beak-trimmed toms of a commercial strain of turkey (Nicholas 88) were vaccinated by hand at the hatchery. A further 75 poults served as unvaccinated controls. The vaccination procedure was as follows: the contents of one 1,000-dose vial of Coccivac-T (Serial No. 38) was removed with a syringe and made up to a final volume of 30 mL with sterile saline. The head of each poult was held on one side and a single drop of vaccine (30 μ L) placed directly on the eye. In all poults, the fluid containing the oocysts was immediately taken up into the nasolacrimal duct. No vaccine was observed to enter the poults via the oral cavity. Poults were then beak-trimmed and injected s.c. via the neck with 0.3 mg of ceftiofur³ solution (a cephalosporin antibiotic active against Gram-negative bacteria) and 10 μ L of a vitamin complex.⁴ Poults were taken directly to the University of Arkansas, where they were observed to be in a vigorous and thriving condition.

Twenty-five vaccinated and 25 unvaccinated poults were placed in separate cages in a clean animal room and given a basal turkey starter ration with no anticoccidial drugs. At 7 d of age, each poult was placed in a plastic bucket for 1 h and a fecal dropping collected. Each dropping was weighed, mixed in 10 mL of

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²Coccivac-T[®], Mallinckrodt Veterinary Inc., Poultry Health Products Group, Millsboro, DE 19966-0537.

³Naxcel[®], The Upjohn Co., Kalamazoo, MI 49001.

⁴durvet-B[®], Durvet Inc., Blue Springs, MO 64015.

TABLE 1. Effect ($\bar{x} \pm \text{SEM}$) of challenge with *Eimeria* species at 3 and 6 wk of age upon the weight gain¹ of turkey poults that had received a coccidiosis vaccine via eyespray at 1 d of age

Poults ²	n	Age when challenged	
		3 wk	6 wk
Challenged	25	431 \pm 17	776 \pm 23
Unchallenged	25	559 \pm 15	826 \pm 24
Probability		≤ 0.0001	≥ 0.05

¹Weight gains measured from Days 0 to 7 postinoculation.

²Poults were challenged with 50,000 oocysts of a mixture of three species of *Eimeria*.

saturated salt solution, an aliquot placed in a McMaster chamber, and the number of oocysts present counted.

Fifty vaccinated and 50 unvaccinated poults were placed in separate pens on new litter at a stocking density of one poult per 0.09 m². They were provided with a commercial prestarter ration (28.6% protein) from 0 to 3 wk and a starter ration (26.5% protein) from 3 to 6 wk containing no anticoccidial drugs. Ten days after vaccination, amprolium⁵ (0.006%) was provided for 48 h in the drinking water. At 3 and 6 wk of age, respectively, 25 of the vaccinated poults were challenged with 50,000 oocysts of a mixture of recent field isolates of *Eimeria adenoides*, *Eimeria gallopavonis*, and *Eimeria meleagrimitis*. Twenty-five unvaccinated poults served as unchallenged controls. Body weight gains from Days 0 to 7 postinoculation were recorded and results compared by Student's *t* test using software of the SAS Institute (1988).

Litter samples were collected from the pens of vaccinated and unvaccinated poults at weekly intervals following placement in the pens. The numbers of oocysts present in the samples were counted as described by Chapman (1992).

RESULTS AND DISCUSSION

All 25 poults that had been inoculated via the eye produced oocysts in their droppings, but no oocysts were found in droppings of the unvaccinated controls. The mean number of oocysts produced per gram of feces was 2,908 (range: 57 to 15,310). No attempt was made to identify the species of *Eimeria* present, but ellipsoidal oocysts corresponding in size to *E. adenoides* and *E. gallopavonis* and ovoid oocysts corresponding in size to *E. meleagrimitis* were observed. It is concluded that administration of oocysts via the eye is an effective method of introducing infection with *Eimeria* species in young turkeys.

Weight gain of vaccinated poults challenged at 3 wk of age was significantly lower ($P < 0.0001$) than that of the unchallenged controls, indicating that they were susceptible to infection (Table 1). No significant differ-

ence in the weight gain of challenged and unchallenged poults was found at 6 wk of age, indicating that the birds had acquired immunity to the *Eimeria* species used for challenge.

Oocysts were present in large numbers (90,900 oocysts per gram) in litter from the pen containing vaccinated poults when the birds were 7 d of age, but no oocysts were found in litter from the pen containing unvaccinated poults. Numbers of oocysts present in the litter of vaccinated poults subsequently declined (data not given). The results suggest that immunity was acquired as a result of exposure to oocysts produced as a result of vaccination, rather than from any parasites that may have been initially present in the pens.

These results demonstrate that the eye is an effective route for establishing infection with *Eimeria* species in day-old turkeys, and that vaccinated poults were resistant to challenge with three species of *Eimeria* by 6 wk of age. Coccivac-T is administered in the hatchery by a machine⁶ that simultaneously inoculates poults via the neck with viral vaccines and sprays the coccidiosis vaccine in the eye. Further experiments are necessary to determine the efficiency of this method of vaccination under commercial conditions.

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⁵Merck AgVet Division, Merck and Co., Inc., Rahway, NJ 07065-0912.

⁶Immunizer[®], Mallinckrodt Veterinary Inc., Poultry Health Products Group, Millsboro, DE 19966-0537.