**Ascardia dissimilis:** the common turkey roundworm

Ascardia dissimilis is a parasitic roundworm that infects the small intestine of turkeys. Infestation with this roundworm is a common and serious problem, especially on farms where litter material is re-used in grow-out barns and sometimes in brooding barns.

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Turkey growers can readily recognise the adult Ascardia worm as a long, thick roundworm in the small intestine. The male is about 35-65 mm long, while the female is about 50-105 mm long. Since the adult worms secrete chemicals that impede the maturation of the larval stages of the species into adults, the presence of a few adults in the intestine, may mask the true severity of the total worm burden (adults + larvae). Although turkeys between the ages of 3 to 12 weeks are the most susceptible, in severe cases birds as young as one week of age may be infested.

The life cycle
Ascardia dissimilis has a direct life cycle; in other words, it needs no intermediate host during its development. The adult females lay thousands of fertile eggs in the intestine of the infected hosts each day, and these eggs are shed to the environment in the droppings. In order for the eggs to become infective to other birds, they must undergo embryonation that results in the development of larvae (immature worms) within the eggs.

Two larval stages (first-stage and second-stage larvae) are developed within the eggs outside host. Under optimum conditions of temperature and humidity, the embryo develops over 10-12 days into second-stage larvae that are infective for other turkeys. In cold weather, it may take fertile eggs up to 20 days to become infective. Ascardia eggs are relatively resistant to many adverse environmental conditions, due to the ova wall, which protects the embryo and developing larvae. When birds ingest infective eggs in the litter or contaminated feed and water, the young worms (larvae) are released, usually in the proventriculus and duodenum, and the second-stage larvae proceed down the intestine where they shed their skin and continue to develop to third-stage-larvae.

The larvae live freely in the lumen of the intestine for about 10 days and then either remain in the lumen or migrate into the mucosa (lining) of intestine. In most cases, the migrating larvae go no further than the mucosa, yet they are capable of causing significant damage to the intestinal wall as they burrow into mucosa. The location of the larvae in the intestinal wall is also called the “tissue phase” of the life cycle. The larvae stay in the mucosa for about 16-18 days and in the case of light infestations, return to the lumen and continue to grow into adults, starting the life cycle over. In heavier infestations, the third-stage larvae are impeded from developing further and remain in the intestinal wall, causing further tissue damage and sometimes forming cysts.

Generally, second-stage larvae are developed into mature adults in about 28-30 days after release from the eggs. Five developmental stages have been recognised in the host; these are three larval stages (second-stage, third-stage, and fourth stage larvae), immature-adult and mature-adult. Under field conditions, various stages of development are present in the bird at the same time. The adult worms may represent only 10% of the total burden of Ascardia infestation; the other 90% are mainly the tissue bound third-stage and fourth-stage larvae, which are located in the lumen. Examination of scrapings of the intestinal mucosa is required to detect the larvae in the wall of the intestine. The late fourth-stage larvae are visible to the naked eye, but microscopic examination is necessary to visualise the small, third-stage larvae.

Migration of larvae from the intestine to the liver occurs in some birds, particularly where the worm burden is very heavy. The route by which the larvae reach the liver was a debatable question, but experimental infections have shown strong evidence that larvae reach the liver via the hepatic portal blood circulation. It is most likely that all larvae that reach the liver eventually die and trigger an intense inflammatory reaction that appears as 1-mm white spots on the surface of the liver. The occurrence of larvae-induced lesions in the liver is considered a specific condition named “hepatic fo-ci”. The condition was a serious problem, and still occasionally occurs in commercial meat-type turkey flocks in the United States.

Effect of the parasite on the host
The negative impact of A. dissimilis infestation on the production performance of turkeys should not be underestimated. It is logical to assume that the effect depends on the number of larvae and adult worms in the intestine. Since the parasite share with the host the nutrients in the feed, infestation can affect feed conversion and causes weight depression. Because the “tissue phase” is the most damaging phase of infestation, it is possible that massive migration of the larvae into the intestinal mucosa is occasionally

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The adult Ascardia is easily recognisable as a long, thick roundworm in the small intestine. (Photo: H John Barnes)
sufficiently severe to result in mortality. Also, since migration of the larvae into and from the wall of the intestine can cause severe damage to the intestinal mucosa, this may predispose birds to secondary infection by opportunistic bacteria. Necrotic enteritis caused by Clostridium perfringens has been associated with heavy migration of Ascaridia larvae into the intestinal mucosa. The condition hepatic foci caused by aberrant migration of larvae to the liver is an economically significant problem for the meat-type turkey industry in the United States. Livers affected with hepatic foci are condemned because they are considered unsuitable for human consumption. Kidneys are simultaneously removed, and thus carcass weight is decreased. In addition, when there is a high incidence of hepatic foci, the processing line may be slowed down because of increased scrutiny by inspectors.

Treatment of Ascaridia dissimilis infestation

The three anthelmintics commonly used to treat turkeys infested with A. dissimilis are piperazine, fenbendazole and levamisole. These three anthelmintics differ in their properties with regard to targeting the adult worms and the larvae. As mentioned previously, adult populations of A. dissimilis inside the host represent the adult worms and the larvae. As in their properties with regard to target- ing a flock diagnosed with Ascaridia infestation in the United States report significant levels of resistance.

Piperazine: The most widely used anthelmintics in the United States for the treatment of turkey flocks infested with A. dissimilis. Piperazine is effective only against adult worms. It is available commercially mainly as piperazine sulfate under different brand names for adminis-

tration via drinking water. Because different commercial products of piperazine sulfate contain different concentrations of piperazine (active ingredients), the dosage of should be calculated on the basis of milligrams of active ingredient (piperazine) per unit of body weight. The recommended dosage is 30-50 mg per pound (66-110 per kilogram) of body weight. The flock should consume drinking water medicated with Piperazine in 4-6 hours. So the first step in medicating a flock is to estimate the amount of water (gallon or litre) that the flock consumes in this period of time (4-6 hours), then the dosage is calculated on the basis of milligrams of active ingredient (Piperazine) per kilogram or pound of body weight. Using the correct dosage and amount of water is very crucial for successful treatment.

Because piperazine is effective only against adult worms but not the larvae, it is necessary to repeat treatment. For “routine” worming of flocks raised in grow-out houses with re-used litter, it is recommended to administer the first treatment 4 weeks after moving the birds from the brooding house, and then every 4 weeks thereafter. After initial treat- ment of a flock diagnosed with Ascaridia infestation at any age, it is necessary to repeat treatment every 4 weeks to target adult worms as they develop from the larvae. The withdrawal time for piperazine sulfate is zero. Efficacy of the medication is variable and some regions in the United States report significant levels of resistance.

Fenbendazole: This was recently approved in the United States under the brand name Safe-Guard™ for use as a feed additive in turkeys to control A. dissimilis and Heterakis gallinarum infestations. It is effective against both larvae and adult worms. The inclusion rate of fenbendazole (active ingredient) in the completed feed is 16 parts per million (16 grams per 1000 kg). The label of Safe-Guard™ indicates initial use at 21 days after moving the birds to the grow-out house, and then repeating the treatment after 28 days.

The duration of treatment is 6 consecutive days. The withdrawal time for fenbendazole is zero.

Levamisole: Very effective in removing both larvae and adult worms. Levamisole is available under different brand names. It is not approved in the United States for use in turkeys, but licensed veterinarians can prescribe it in an extra-label fashion. Levamisole is available commercially as a solution or powder of levamisole hydrochloride for administration via drinking water. As with Piperazine, the dosage should be calculated on the basis of milligrams of active ingredient per kilogram or pound of body weight. The recommended dosage for turkeys for controlling A. dissimilis is 13.5-16 per pound (30-35 mg per kilogram) of body weight. The treated flock should consume the medicated water in a 4-6 hour period. The withdrawal time of levamisole hydrochloride in cattle and swine is 3 days.

Prevention strategies

The most critical measure in preventing Ascaridia infestation in problem farms is the more frequent removal of used litter, followed by thorough cleaning (including washing) and disinfection of the house, especially the floor. It is important to realise that commonly used disinfectants have no effect on the eggs of Ascaridia. Although some proponents advise the application of salt at a rate of 60 pounds (30 kilograms) per 1000 square feet (93 square meters) on the ground after removing litter, the practice is detrimental to equipment and can cause problems with groundwater contamination during cleanout. Desiccation of sufficient duration (dependent on environmental conditions) is detrimental to Ascaridia eggs and therefore houses should be allowed to dry completely before placing a new flock. If possible, supplementation of additional heat to raise the temperature of the barn for a minimum of three days is very helpful, especially in winter. Even when the litter in the house is re-used, it is always beneficial, if possible, to heat the empty house for a minimum of three days before placing a new flock. Alternatively, stacking the old litter in a pile for 7-10 days will probably kill Ascaridia eggs due to the high temperature in the pile. Although no study has been done to determine the efficiency of this method, it has been shown that a 12-hour exposure at 43°C (110°F) kills the eggs at all stages of development. A pile of litter most likely reaches a temperature higher than 43°C. Once removed from the house, litter should be removed completely from the premises to prevent recontamination.