Trichostrongylus colubriformis

Trichostrongylus colubriformis are intestinal parasites of sheep and goats that are commonly known as bankrupt worms, black scour worms, invisible worms, or small parasites of the intestine. These last two names allude to the tiny size of adult parasites, since they are difficult to see with the naked eye.

Adult males and females of *T. colubriformis* inhabit the small intestine of virtually all sheep and goats that graze in warm, humid, and temperate climates. The species is one of the three most common and abundant gastrointestinal nematodes (worms) in animals with mixed infections. They can be even more numerous than *Haemonchus contortus* (barber pole worm) in warm and humid areas. In temperate zones, you can also find *Trichostrongylus axei* worms, but this species parasitizes the abomasum of animals and has different effects compared to the intestinal parasite.

LIFE CYCLE

The adults of this parasite attach to the intestinal villi causing their abrasion and destruction. Adult females are more abundant and larger than males (Figure 1 A, B). The later fertilize females that begin to lay eggs. Females have low fertility, averaging only 29 eggs per day. Adult females have on average 18 eggs in their uterus when they are removed from the intestine, although 20 percent of these lack eggs (Figure 1 C, D).

The eggs of *T. colubriformis* exit into the intestinal lumen (space within the intestines) and are excreted in the feces of sheep or goats. When their fecal excretion coincides with rainfall, eggs can develop to first stage larvae (L1) within the feces in about 48 hours, and subsequently pass into second stage larvae (L2) and can reach the third stage (L3) in about 5 to 14 days, depending on the ambient temperature (Figure 2). The L3 larvae have an external sheath characteristic of the genus, with a very short sheath tail (25 µm; Figure 3). The L3 can come out of the feces at 5 days in hot humid climates, but can take 14 days or more in temperate and cold climates. The L3 move away from feces and climb in the surrounding vegetation to reach those layers of plants that are consumed by the animals. The L3 can remain viable for a few weeks in hot and humid areas, but die quickly in periods of drought; although, studies in Australia suggest that the L3 can be reactivated at the onset of the rainy season.

In temperate or cold climates, the L3 can remain viable for several months. Sheep and goats become infected by consuming plants contaminated with the third stage larvae (L3). Twenty one to 35 days after

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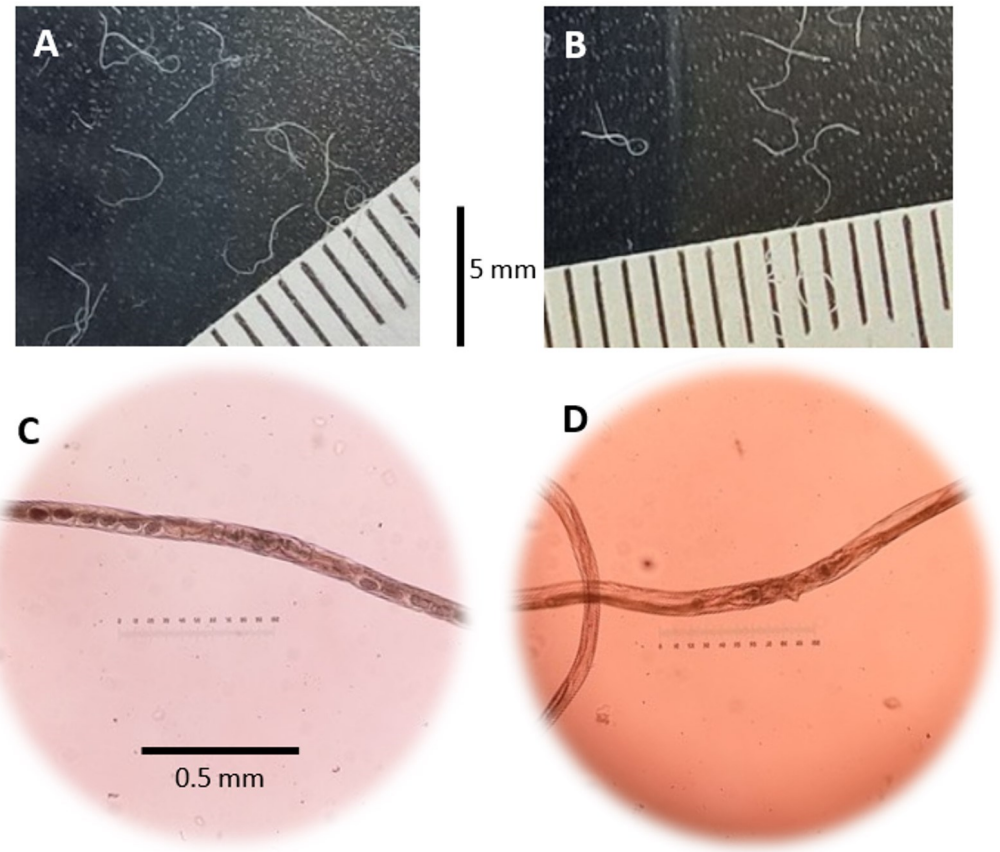
infection, the L3 reach the adult phase. In that period, the L3 lose their sheath before reaching the small intestine; then, they molt as fourth stage larvae (L4) that invade the intestinal mucosa where they remain for variable periods of time, depending on different conditions of the animal and the external environment. The L4 leave the lumen to molt as L5 larvae which will finally reach the adult stage. Female and male adults mate and produce eggs.

In pure *T. colubriformis* infections, a fecal egg count of 1,000 egg per gram of feces (EPG) translates to about 16,000 adult parasites. A similar number of *Haemonchus contortus* eggs can be produced by only about 250 adult females. This means that the feces of animals with mixed natural infections may contain more *H. contortus* eggs than *T. colubriformis* eggs, but the adult *T. colubriformis* population is much more abundant.

Figure 1

Adults of *Trichostrongylus colubriformis*, observed with the naked eye: (A) Females and (B) Males. Detailed observations under a microscope with the 10X objective: (C) Uterus with eggs, (D) Uterus without eggs. Images by Gabriela Mancilla-Montelongo.



IMPACT OF THE PARASITE

T. colubriformis damage the villi of the small intestine. Villi are small, finger-like projections that line the small intestines. Their role is to increase surface area within the small intestine. Such damage is caused by the L4 larvae lodged at the base of the intestinal villi, affecting the regeneration capacity of the villi. In addition, the attachment of L5 larvae and adults causes villi abrasion. Animals infected with *T. colubriformis* are generally asymptomatic. However, severe infections (more than 15,000 adults) can result in reduced weight gain due mainly to reduced feed intake. In addition, animals divert ingested nutrients towards tissue repair and immune response, limiting nutrient availability for production goals, such as weight gain and milk production. In some cases of severe infection, the digestibility of ingested food is reduced. However, a reduction in nutrient absorption has not been demonstrated, as it seems to be recovered in the posterior end of the small intestine.

Figure 2

Different *Trichostrongylus colubriformis* life-stages observed in a compound microscope (10X): (A) egg, (B) egg with an L1 larva, (C) L1 larva, (D) L2 larva, (E) L3 larva. Images by Gabriela Mancilla-Montelongo.

DIAGNOSIS

Infections with *T. colubriformis* can be difficult to distinguish from signs of malnutrition, such as low body condition in adult animals or low weight gain in growing animals. Most animals infected with *T. colubriformis* have normal stools. However, some animals with high infections may have abundant mucus, pasty stools, or even diarrhea. In some cases, fecal pellets are observed linked as in a chain (Figure 4). Diarrhea caused by high burdens of *T. colubriformis* is black, while that caused by coccidia (*Eimeria* spp.) has a lighter color in earth tones.

To know which animals have high burdens of *T. colubriformis*, fecal egg counting must be performed using the modified McMaster or Mini-FLOTAC techniques. The eggs of this species are easy to differentiate from coccidia; however, they are indistinguishable from those of other gastrointestinal worms. Because of this, it is necessary to do fecal cultures to obtain L3 larvae that can be used to differentiate the genera of worms. The L3 of *T. colubriformis* have a square head and a small sheath tail (Figure 2E and 3). At necropsy, adult *T. colubriformis* generally go unnoticed because of their small size. They have a length of 6 to 9 mm and the

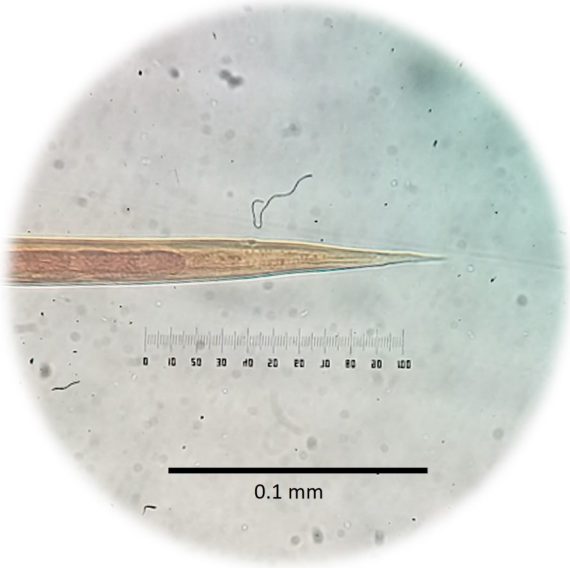


Figure 3

Close-up of the *Trichostrongylus colubriformis* L3 larva tail observed with the 40X objective showing the short sheath tail of approximately 0.025 mm. Images by Gabriela Mancilla-Montelongo.

width of thin hair (Figure 1 A, B). Even in severe infections with more than 15,000 adults, it is not possible to perceive them with the naked eye when inspecting the inside of the viscera at necropsy. They can only be found by inspecting the intestinal contents after placing them in a separate container. Adult counting must be performed by trained personnel using a magnifier stereoscope.

TREATMENT

This species of parasites is usually susceptible to different classes of commercial dewormers such as benzimidazoles (SafeGuard®, Valbazen®), imidazothiazoles (Prohibit®, Leva-Med®), macrocyclic lactones (Ivomec®, Cydectin®), monepantel (Zolvix®) and derquantel. However, closantel and other salicylanilides have no activity against this parasite species. There are numerous reports of *T. colubriformis* populations that can resist a single family of dewormers, but there are also multi-drug-resistant populations, which survive conventional doses of several dewormers mentioned above.

To slow down the development of dewormer resistant populations, it is suggested to implement a targeted selective treatment strategy directed only to those animals that are affected by mixed natural infections. It is suggested to combine more than one criterion to decide treatment, for example, a low body condition (≤ 2) and a high fecal egg count (>1000 EPG). The FAMACHA© system has no biological relevance except when mixed infections include significant barber pole worms.

Figure 4

In some cases, fecal pellets are observed linked as in a chain. Image by Pedro D. Ek-Pinelo.

PREVENTION

In lambs, immunity against these parasites begins to be evident at 2 to 3 months after infection, and this coincides with the moment of greater impact on the growth of these animals. Sheep and goats 3 to 5 months of age may eliminate their parasites on their own from week 6 post-infection, and can even counteract further re-infections. The duration of this protection is unknown.

Several alternative methods can help control *T. colubriformis* in sheep and goat herds. These include nutritional supplementation, the use of nutraceutical materials, genetic selection, and nematophagous fungi (*Duddingtonia flagrans*; BioWorma®). In hot and humid tropical areas, it is useful to implement a rotational grazing program. Two alternatives which are not effective against *T. colubriformis* are copper oxide wire particles (COWP) and the Barbervax® vaccine.

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Not all products mentioned in this factsheet are available in the United States or other places. Barbervax® (the vaccine for the barber pole worm) is currently not licensed in the US. Closantel, monepantel, and derquantel are also not available to US producers.

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