Nodule or Nodular Worm (*Oesophagostomum*)

The genus of parasitic nematodes (roundworms), *Oesophagostomum,* is a member of the superfamily *Strongyloidea* (order *Strongylida*). These worms have an intense impact on many animals worldwide. Ruminants, swine, primates, and humans can all be infected by *Oesophagostomum* roundworms. Also called nodule or nodular worms, this parasite is most prevalent in warm climates with high rainfall.

Oesophagostomum columbianum is a parasite of concern for sheep and goats amongst the roundworms. It does not threaten swine or primates. The nodule worm as an adult resides in the large intestine of the small ruminant while also wreaking havoc on the intestine's structure and the health of the animal in its entirety.

LIFE CYCLE

Nodular worms thrive in warm climates and are highly susceptible to cold weather; these worms in any life stage will not survive freezing temperatures. In a warm and moist pasture, nodule worm eggs in the deposited feces of an infected animal will hatch and yield larvae. These larvae will grow (into stage 1 and stage 2), become infective (stage 3), and either die in the pasture due to undesirable conditions or be ingested by another animal.

When ingested, the third-stage larvae will shed their protective outer coating or sheath for the worm to further invade the animal's gastrointestinal tract. It is here that they develop into fourth-stage larvae. The fourth-stage larvae will either remain in the wall of the ileum or migrate into the large intestine wall (Figure 1). The worms that migrate will cause a severe inflammatory response in the large intestine. This inflammatory immune response causes the formation of mineralized nodules (chronic granulomas and nodular enteritis) in the large intestine (Figure 2). As the larvae continue progressing into the adult stage, the intestinal lining continues to be exposed to more damage.

In just five weeks, the nodule worm larvae are ingested, mature into adults, reproduce, and continue their life cycle by excreting eggs in the animal's feces. The nodule worms will continue living in the animal until treatment intervenes.

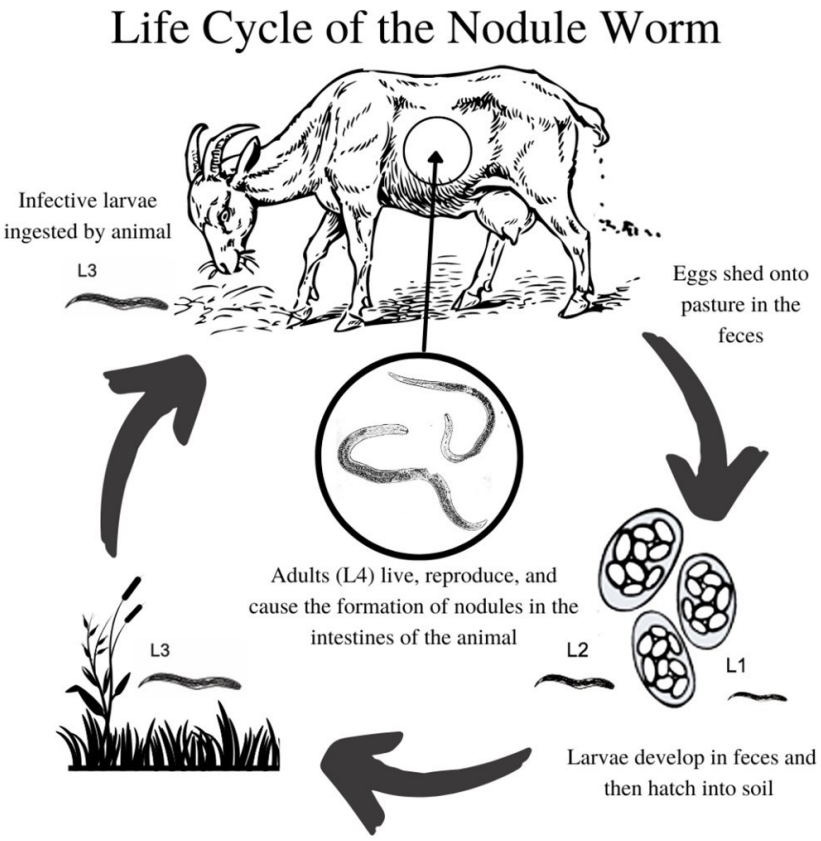

Figure 1.
Life Cycle of *Oesophagostomum columbianum* (nodule worm). By: Lindsey Dearborn

IMPACT IN THE ANIMAL

The nodule worm has been identified as the primary agent causing nodular enteritis in the small intestine of small ruminants globally. Nodular enteritis yields a massive impact on the health and productivity of the animals. Meat yield and quality, body condition score, immune response, and other economically important factors are all extremely impacted by the occurrence of nodular enteritis. In some cases, nodules can also be found in the small intestine, lung, liver, and lymph nodes.

Larvae penetrate the mucosa from the large intestine and move into deeper areas of the intestinal wall. This causes an inflammatory reaction as well as the formation of nodules and intestinal lesions that affect peristalsis, causing diarrhea, constipation, weakness, and severe weight loss. Malabsorption and therefore malnourishment in the animal is inevitable when the intestinal lining is so damaged. Nodular worms can also cause peritonitis (severe swelling of the abdomen) if the nodules cause intestinal rupture. In severe cases in which an animal has high counts of nodular worms and is experiencing nodular enteritis as a result, death is likely to occur.

In an adult goat or sheep, a "heavy" worm count of nodular worms is 500 eggs per gram (EPG) of feces. A nodule worm count of 100 EPG is deemed pathogenic in a weaning animal. When the animal is an adult, this pathogenic EPG increases to 200-300. A female nodular worm will produce anywhere from 5,000 to 12,000 eggs per day.

PREVENTION

Evidence of anthelmintic resistance demonstrated by nodular worms has been reported worldwide. However, their ability to survive anthelmintic intervention is not as adept as other parasites, such as the highly documented ability demonstrated by *Haemonchus contortus* (barber pole worm). Therefore, there is still hope for the three classes of anthelmintics available in the United States to combat nodular worm infection.

Still, it remains important to prevent initial infection and only treat it when necessary. Regular evaluation for symptoms such as low body condition, loss of weight, and diarrhea should be conducted. Sustainable deworming practices must be kept in mind, such as using rotational grazing management practices, and integrating bioactive forages into the grazing sheep and goat diet as preventative practices against the nodular worm.

Figure 2. Nodules in the large intestine of sheep due to *Oesophagostomum columbianum* (nodule worm).

Image credit: Jane Lamb, Invetus, Armidale. Image retrieved 12/22/22 from Love, Stephen.

REFERENCES

Love S, 2017. Nodule worm of sheep. NSW Government, Department of Primary Industries. Primefact 810 3rd edition. Accessed 12/22/22 at https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/248909/Nodule-Worm-of-Sheep.pdf

Nath TC, Lee D, Park H, Choe S, Ndosi BA, Kang Y, Bia MM, Eamudomkarn C, Mohanta UK, Islam KM, Bhuiyan JU, Jeon HK, Eom KS. 2021. Morphometrical and Molecular Characterization of *Oesophagostomum* columbianum (*Chabertiidae:* Oesophagostominae) and Haemonchus contortus (Trichostrongylidae: Haemonchinae) Isolated from Goat (*Capra hircus*) in Sylhet, Bangladesh. J Parasitol Res. Feb 24; 2021:8863283. doi: 10.1155/2021/8863283. PMID: 33708439; PMCID: PMC7932798. Accessed 12/22/22 at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7932798/

Underwood WJ., Blauwiekel R., Delano ML., Gillesby R., Mischler SA., Schoell A., 2015. Chapter 15 - Biology and Diseases of Ruminants (Sheep, Goats, and Cattle), Editor(s): James G. Fox, Lynn C. Anderson, Glen M. Otto, Kathleen R. Pritchett-Corning, Mark T. Whary. In American College of Laboratory Animal Medicine, Laboratory Animal Medicine (Third Edition), Academic Press. Pages 623-694. ISBN 9780124095274. https://doi.org/10.1016/B978-0-12-409527-4.00015-8.

Nodule worms are most prevalent in warm climates with high rainfall.

Image by Susan Schoenian

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