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Morphological and morphometric characterization of *Trichuris ovis* (Nematoda: *Trichuridae*) recovered from a naturally infected goat

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Abstract

Trichuris ovis is a common gastrointestinal nematode parasitizing the caecum and colon of domestic ruminants, causing reduced productivity and economic losses worldwide. Accurate species identification is essential for diagnosis, epidemiological investigations, and parasite taxonomy. The present study was undertaken to describe the morphological and morphometric characteristics of *T. ovis* recovered from a naturally infected goat. The large intestine of a four-year-old male goat obtained from a slaughterhouse in Bareilly, Uttar Pradesh, India, was examined for gastrointestinal nematodes. Adult worms recovered from the caecum and colon were washed, cleared in lactophenol, and examined under a light microscope. Approximately 35 adult worms were identified as *T. ovis* based on standard taxonomic characteristics. Adult males measured 29.54–64.50 mm in length and 0.25–0.66 mm in width, whereas females measured 53.20–76.10 mm in length and 0.38–0.76 mm in width. Both sexes exhibited the characteristic whip-like body with a slender filiform anterior portion comprising nearly three-fourths of the total body length and a thicker posterior region. The anterior extremity lacked lips and contained a small buccal cavity with a spear-like structure. A prominent bacillary band and a stichosome oesophagus composed of a single row of stichocytes were observed. Male worms possessed a spirally coiled posterior extremity with a single spicule measuring 4.7–6.2 mm enclosed within a densely spined spicular sheath, whereas females exhibited a gently curved posterior end with the vulva located near the oesophago-intestinal junction. Characteristic lemon-shaped eggs with thick shells and conspicuous bipolar plugs were observed both within the uterus and in faecal samples. The morphological and morphometric findings were consistent with the established descriptions of *T. ovis*, confirming that detailed morphological examination remains a reliable and practical method for species identification and provides valuable baseline information for future taxonomic, epidemiological, and molecular studies of *Trichuris* infections in small ruminants.

Keywords: *Trichuris ovis*, morphology, morphometry, goat, gastrointestinal nematode, whipworm

Introduction:

Trichuris ovis is one of the most prevalent gastrointestinal nematode parasites infecting the caecum and colon of domestic ruminants, including sheep, goats, and cattle, irrespective of age, sex, or breed. The parasite is widely distributed throughout tropical and temperate regions and continues to cause considerable economic losses through reduced growth, poor feed conversion, decreased productivity, and increased susceptibility to secondary infections (Soulsby, 1982; Bowman, 2002; Taylor *et al.*, 2016). Despite more than a century of research on its biology and control, *T. ovis* remains an important constraint to sustainable ruminant production worldwide (Kuchai *et al.*, 2013).

The genus *Trichuris* comprises several species of medical and veterinary importance, including *T. trichiura* in humans, *T. suis* in pigs, *T. vulpis* in dogs, and *T. ovis* in domestic ruminants (Beer, 1973; Taylor *et al.*, 2016). Infection with *Trichuris* spp., commonly known as trichuriasis or whipworm disease, results in chronic inflammation of the caecum and colon, leading to weight loss, poor body condition, anaemia, diarrhoea, and reduced production efficiency. In severe infections, particularly in young animals, bloody colitis, diphtheritic caecitis, ulceration, dehydration, and mortality may occur (Soulsby, 1982; Bowman, 2002; Taylor *et al.*, 2016) [15, 4, 16, 2, 4, 11].

The life cycle of *T. ovis* is direct and does not involve an intermediate host. Infection occurs through ingestion of embryonated eggs from contaminated pasture, feed, or water. Following hatching in the small intestine, larvae migrate to the caecum and proximal colon, where the slender anterior portion of the worm embeds deeply into the intestinal mucosa, forming characteristic syncytial tunnels within epithelial cells, while the posterior end remains free in the lumen for copulation and egg shedding (Jenkins, 1970; Beer, 1973; Panesar, 1980; Cliffe and Grencis, 2004) [6, 9]. This unique host–parasite interaction contributes to mucosal damage and chronic inflammatory changes in infected animals [2, 14].

India possesses one of the world's largest livestock populations, with goats and sheep contributing substantially to rural livelihoods and the national economy. Consequently, gastrointestinal nematode infections, including trichuriasis, represent an important constraint to livestock productivity and profitability (Government of India, 2012) [8]. Although modern broad-spectrum anthelmintics have substantially improved parasite control, the rapid emergence and spread of anthelmintic resistance among gastrointestinal nematodes threaten the long-term sustainability of current control programmes (Kaplan and Vidyashankar, 2012). This has intensified interest in alternative parasite control strategies, including vaccine development, biological control, molecular diagnostics, genetic markers, and selective breeding for parasite-resistant animals (Kuchai *et al.*, 2013) [10, 11].

Future sustainable management of *T. ovis* infections will depend on a comprehensive understanding of the parasite's morphology, life cycle, epidemiology, pathogenic mechanisms, and host immune responses. In this study, we have reported and studied the morphological features of *Trichuris ovis* nematode parasite.

Materials and Methods

The complete large intestine, comprising the caecum, colon, and rectum, was collected from a 4-year-old male goat at a local slaughterhouse in Datia, Madhya Pradesh, during June 2026. Immediately after collection, the intestine was transported to the laboratory and examined for the presence of gastrointestinal nematodes. The external surface of the large intestine was carefully inspected for gross pathological changes associated with parasitic infection, including haemorrhagic lesions, thickening of the intestinal wall, ulceration, nodules, or cystic structures.

The intestine was longitudinally opened using sterile scissors, and the luminal contents of the caecum and colon were collected separately into clean containers. The intestinal contents were diluted with distilled water, thoroughly mixed, and passed through a sieve of appropriate mesh size to recover adult nematodes. The washing and sieving procedure was repeated several times until no additional worms were recovered. Approximately 35 adult *Trichuris* worms were collected and washed repeatedly with distilled water followed by phosphate-buffered saline (PBS) to remove adhering debris and intestinal contents. The recovered worms were subsequently transferred to lactophenol solution and kept overnight at 4°C for clearing. Cleared specimens were examined under a light microscope at 10× and 40× magnifications for morphological identification. Species identification was carried out based on standard taxonomic keys using characteristic

morphological features such as the slender whip-like anterior end, thick posterior body, cephalic region, bacillary band, oesophageal morphology, and overall body dimensions. Sex differentiation was performed by examining reproductive structures, including the spicule, spicular sheath, and caudal morphology in males, and the position of the vulva, anus, and posterior extremity in females. Morphological identification of the recovered specimens was performed according to the descriptions provided by Soulsby (1982), Bowman (2002), Taylor *et al.* (2016) and Mishra *et al.* (2024) [4, 13, 15, 16].

Results

Adult specimens recovered from the caecum and colon were identified as *Trichuris ovis* based on their characteristic morphological features. The adult male worms measured 29.54–64.50 mm in length and 0.25–0.66 mm in width, whereas the adult females measured 53.20–76.10 mm in length and 0.38–0.76 mm in width (Figure 1). Both sexes possessed a characteristic whip-like appearance, with a slender filiform anterior portion constituting approximately three-fourths of the total body length and a comparatively thicker posterior end.

The anterior extremity was devoid of lips and contained a small buccal cavity provided with a spear-like structure (Figure 2). The cuticle exhibited distinct transverse striations along with a prominent longitudinal bacillary band. The oesophagus consisted of a narrow tube surrounded by a single row of large glandular cells (stichocytes), forming a characteristic stichosome (Figures 3). Figure 4 depicts the intestine of the *Trichuris* worm. The eggs observed within the uterus were lemon- or barrel-shaped, possessing thick shells with conspicuous bipolar plugs, which are typical diagnostic features of *Trichuris* species.

Male worms possessed a spirally coiled posterior extremity bearing a single spicule measuring 4.7–6.2 mm in length. The spicule exhibited a slightly expanded proximal end and a pointed distal tip. It was enclosed within a spicular sheath measuring approximately 1.39 mm, which was densely covered with fine spines and terminated in a slightly expanded globular distal end (Figure 5).





Fig 1 and 2: Collected *Trichuris* worms in PBS. 2) Male & Female - Anterior end of *Trichuris* worm



Fig 5 and 6: Spicule Sheath. 6) Posterior end of male *Trichuris* worm

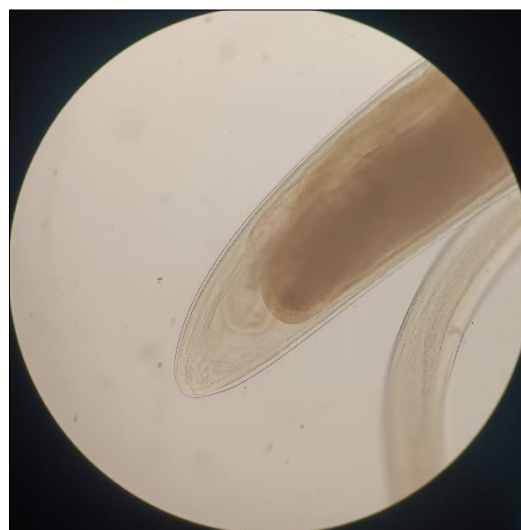


Fig 3 and 4: Male & Female *Trichuris* - Stichosome with one row of stichocytes. 4) Male & Female *Trichuris* - Intestine

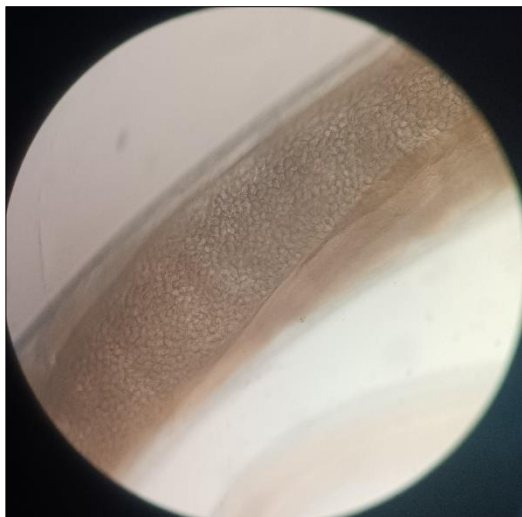


Fig 7 and 8: Female *Trichuris* - Posterior end. 8) Female *Trichuris* - Oviduct filled with ova

In contrast, the posterior extremity of female worms was gently curved without coiling (Figure 6 and 7). The vulvar opening was located near the oesophago-intestinal junction, and the uterus contained numerous fully developed eggs arranged in a single row (Figure 8). The faecal contents were examined by wet mount method of faecal egg examination and found typical lemon shaped or barrel shaped eggs with polar plugs (Figure 9).



Fig 9: *Trichuris* Spp. Egg

Discussion

The present study confirmed the occurrence of *Trichuris ovis* in sheep based on detailed morphological examination of adult worms recovered from the caecum and colon, together with the characteristic morphology of eggs detected in faecal samples. The diagnostic features observed, including the whip-like body, a slender filiform anterior portion comprising approximately three-fourths of the total body length, and a comparatively thicker posterior end, are consistent with the generic characteristics described for *Trichuris* species infecting domestic ruminants (Soulsby, 1982; Taylor *et al.*, 2016; Anderson *et al.*, 2009) ^[1, 15, 16].

Morphometric analysis revealed that adult male worms measured 29.54–64.50 mm in length and 0.25–0.66 mm in width, whereas females measured 53.20–76.10 mm in length and 0.38–0.76 mm in width. As reported previously, female

T. ovis are generally larger than males owing to their well-developed reproductive system (Yamaguti, 1961; Soulsby, 1982). The body measurements obtained in the present investigation are comparable to those reported in sheep and goats from different geographical regions (Lichtenfels *et al.*, 1994; Taylor *et al.*, 2016), although minor variations in morphometric parameters have been attributed to differences in host species, age of worms, parasite burden, nutritional status of the host, environmental conditions, and fixation techniques (Anderson *et al.*, 2009) ^[12, 15, 16].

The anterior extremity observed in the present study lacked lips and possessed a small buccal cavity with a spear-like structure. The oesophagus consisted of a narrow tube surrounded by a single row of large glandular cells (stichocytes), forming the characteristic stichosome oesophagus of trichurid nematodes. Similar observations have been reported in previous taxonomic descriptions of *Trichuris* species and are regarded as important diagnostic features of the family *Trichuridae* (Yamaguti, 1961; Anderson *et al.*, 2009). The prominent longitudinal bacillary band observed along the cuticle also agrees with earlier descriptions and has been suggested to play an important role in secretion, absorption, and osmoregulation during the parasite's intimate association with the intestinal mucosa (Bird and Bird, 1991) ^[1, 3].

The morphology of the male posterior extremity observed in the present study, including the spirally coiled tail, single spicule measuring 4.7–6.2 mm, and the spiny spicular sheath terminating in a slightly expanded distal end, closely resembles previous descriptions of *T. ovis* (Yamaguti, 1961). The spicular sheath ornamented with fine spines represents one of the most important taxonomic characteristics for differentiating species within the genus *Trichuris* (Anderson *et al.*, 2009). Likewise, the gently curved posterior extremity of female worms, vulvar opening situated near the oesophago-intestinal junction, and uterus filled with numerous eggs arranged in a single row correspond well with earlier descriptions (Soulsby, 1982; Taylor *et al.*, 2016) ^[1, 17].

The eggs observed both within the uterus and during faecal examination were characteristically lemon- or barrel-shaped with thick shells and conspicuous bipolar plugs, which are considered classical diagnostic features of *Trichuris* species (Soulsby, 1982; Zajac and Conboy, 2022). Routine coprological diagnosis largely depends on the identification of these characteristic eggs; however, species-level differentiation based solely on egg morphology is difficult because of considerable overlap in egg dimensions among different *Trichuris* species infecting ruminants (Taylor *et al.*, 2016). Therefore, recovery and morphological examination of adult worms remain the gold standard for definitive species identification ^[15, 16].

Although conventional morphology remains the cornerstone for the diagnosis and taxonomy of *Trichuris* spp., morphological similarities among closely related species may occasionally complicate species identification, particularly in immature or damaged specimens (Cutillas *et al.*, 2009). Consequently, molecular approaches based on the internal transcribed spacer (ITS-1, ITS-2) regions of ribosomal DNA and mitochondrial genes such as cytochrome c oxidase subunit I (*cox1*) have increasingly been employed to improve species discrimination and investigate phylogenetic relationships among *Trichuris* populations infecting domestic and wild ruminants (Cutillas

et al., 2009; Callejón *et al.*, 2013) [7]. Although molecular characterization was beyond the scope of the present study, combining detailed morphological observations with molecular techniques would provide a more robust framework for species identification and epidemiological investigations [5].

Overall, the morphological and morphometric characteristics documented in the present study correspond closely with the established descriptions of *Trichuris ovis* reported from small ruminants worldwide (Yamaguti, 1961; Soulsby, 1982; Anderson *et al.*, 2009; Taylor *et al.*, 2016). The present findings reaffirm that careful examination of adult worms remains a reliable and practical approach for the identification of *T. ovis* and provides valuable baseline data for future taxonomic, epidemiological, and molecular studies [1, 15, 16, 17].

Conclusion

The present study provides a detailed morphological and morphometric characterization of *Trichuris ovis* recovered from the caecum and colon of sheep. The observed diagnostic features, including the characteristic whip-like body, stichosome oesophagus, spirally coiled male posterior extremity with a spiny spicular sheath, and the typical lemon-shaped eggs with bipolar plugs, were consistent with the established descriptions of *T. ovis*. The morphometric measurements recorded in the present investigation were within the range reported in previous studies, confirming the identity of the parasite. These findings demonstrate that detailed morphological examination of adult worms, complemented by coprological identification of characteristic eggs, remains a reliable and practical approach for the diagnosis of *T. ovis* infection. The baseline morphological data generated in this study will contribute to the accurate identification of *Trichuris* species and provide a useful reference for future taxonomic, epidemiological, and molecular investigations in small ruminants.

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