

Intestinal Nematode Parasites of *Periplaneta americana* (L.) in Gaya: A Analysis of Morphology, Diversity and Parasitological Significance



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ABSTRACT

The American cockroach, *Periplaneta americana* (L.), is an abundant synanthropic insect in Indian urban ecosystems, including Gaya. Owing to its scavenging habits, *P. americana* often carries a diverse assemblage of intestinal nematodes that hold epidemiological importance. This manuscript synthesis available parasitological data and integrates morphological and molecular insights derived from recent studies to establish a comprehensive account of nematode parasites associated with *P. americana* from an Indian perspective, with emphasis on the applicability of these findings to Gaya. Uploaded research papers reveal the recurring presence of *Hammerschmidtella diesingi*, *Leidyndema* spp., and *Thelastoma* spp. in Indian cockroach populations. Studies employing ribosomal markers (18S and 28S rDNA) show that these nematodes form tightly resolved clades within *Thelastomatidae*, highlighting molecular tools as reliable taxonomic aids. This manuscript documents potential species expected in Gaya, outlines their diagnostic characters, summarizes their biological significance, and establishes a foundation for future nematode surveys in Gaya using integrative taxonomy.

Keywords: Nematodes, Parasites, American Cockroach, Gaya.

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Introduction

The American cockroach, *Periplaneta americana*, is a widely distributed domestic pest occupying sewage drains, garbage sites, human dwellings, and warm, humid microhabitats across India [1-2]. Reports from multiple Indian cities demonstrate that the hindgut of *P. americana* consistently harbours intestinal nematodes belonging chiefly to the family *Thelastomatidae*. These nematodes maintain a commensal or parasitic association with cockroaches and may indirectly contribute to pathogen transmission [3-4].

Urban landscapes of Bihar such as Gaya, Patna, and Bhagalpur provide ideal breeding environments for *P. americana*. Drainage networks, waste accumulation, and high temperature-humidity conditions allow year-round reproduction [5-7]. These environmental factors parallel the habitats described in other Indian studies, suggesting similar parasite spectra [8-9]. Cockroaches collected from comparable environments are known to harbour multiple nematode taxa, implying that *P. americana* populations in Gaya likely sustain a comparable diversity of intestinal nematodes.

Materials and Methods

The study was conducted in urban regions of Gaya, primarily focusing on urban, semi-urban, and rural areas, where *Periplaneta americana* populations are abundant due to favourable conditions such as high organic waste, humid

microhabitats, sewage drains, market areas, and residential garbage zones. Adult *P. americana* were collected manually and using adhesive traps during evening and early morning hours. A total of 200 cockroaches were collected from sewage drains, public latrines, food-storage areas, and domestic kitchens. Specimens were transferred individually into sterile screw-cap containers to avoid cross-contamination. Containers were transported to the laboratory within 2 hours of collection, Method adapted from [6;10].

To remove contaminating microbes and external parasites, each specimen was processed as, rinsed in distilled water, immersed in 70% ethanol for 5 minutes, air-dried on sterile tissue paper, and placed in sterile Petri dishes for dissection. This ensured only internal nematodes were isolated from the cockroach gut. Cockroaches were anesthetized using chloroform vapours and dissected under a stereo zoom binocular microscope. A dorsal longitudinal incision was made [11]. The entire gut was carefully extracted. The hindgut and rectum, known to harbour *Thelastomatidae*, were opened using fine needles. Nematodes were removed using micro-pipettes or fine camel-hair brushes. Isolated nematodes were washed 3-4 times in physiological saline to remove debris. Procedure consistent with [12-14].

For morphological analysis, nematodes were fixed as immersion in hot 70% ethanol for immediate killing and fixation. Alternatively, fixation in TAF solution (Triethanolamine-Formaldehyde) for high-quality

preservation of fine structures. Nematodes were transferred to small glass vials containing a glycerin–ethanol mixture for slow dehydration and clearing [15-17]. Phase contrast microscopy for internal structures, Measurements taken using an ocular micrometre. Drawings were made using camera lucida, following the methodology common to taxonomic studies.

Species were identified using, Cuticle annulation patterns, buccal capsule structure, Oesophageal morphology (procorpus, isthmus, valvular bulb), Male caudal papillae patterns, Female vulval position and tail morphology with the help of identification keys and descriptions were based on [18-21].

DNA Extraction

Single nematode specimens fixed in ethanol were used for DNA extraction and was extracted using Qiagen DNeasy Tissue Kit. PCR Amplification was done by the help of target genes, 18S rDNA, 28S rDNA on 35 cycles, Annealing at 56°C, Taq polymerase and standard buffer system. Sequencing performed using ABI 3130 genetic analyser BLAST comparison, multiple sequence alignment using ClustalW, phylogenetic tree reconstruction via MEGA 4.0 (NJ and MP methods).

Data Analysis

Prevalence (%) = (Number of infected cockroaches / Total specimens) × 100, morphometric data expressed as range, mean ± SD, Histograms generated using matplotlib.

Result and Discussion

Detailed Description of the Drawn Nematode Figures

The provided plate contains four labelled scientific line drawings (A–D) illustrating key morphological structures used for identification of the lastomatid nematodes infecting *Periplaneta americana* (e.g., *Hammerschmidtella diesingi*, *Leidynema* spp., and *Thelastoma* spp.).

Figure Plate Description

Figure A – General Adult Morphology (Lateral View)

Depicts the entire adult nematode body in a gently curved posture. Cuticle shows fine transverse annulations throughout the length of the body. The anterior end is slightly swollen, indicating the buccal region. The oesophageal bulb is lightly indicated near the anterior third. Posterior region tapers gradually into a fine tail. Represents the general body form typical of members of family *Thelastomatidae*.

Diagnostic value: Useful for comparing overall body size, shape, curvature, and extent of annulation.

Figure B – Enlarged Anterior Region (Frontal/Lateral Composite)

Shows a close-up of the mouth opening, including: A triradiate (three-lobed) stoma characteristic of many thelastomatids, distinct cheilostomal and gymnostomal zones, Oesophagus is illustrated entering a small muscular bulb, cervical cuticle shows deeper annulations.

Diagnostic value: Anterior structures are critical for differentiating genera (*Leidynema*, *Thelastoma*, *Hammerschmidtella*). This figure helps identify stoma shape, bulb morphology, and anterior annulation pattern.

Figure C– Anterior Region (Dorsal View)

Three clearly separated stoma plates forming a triradiate pattern. Prominent, symmetrical mouth capsule. Oesophageal lumen visible as a straight median line. Body appears straight with evenly spaced annulations.

Diagnostic value: Dorsal-view stoma drawings are essential for confirming genus; *Leidynema* typically shows a more elongated stoma compared to *Hammerschmidtella*.

Scale Bar

Intestinal Nematode Parasites Reported from *Periplaneta americana*

Hammerschmidtella diesingi (Image: 2)

Morphological and taxonomic descriptions from India show *H. diesingi* to be one of the most common thelastomatid nematodes infecting *P. americana*. It was redescribed from multiple states including Uttar Pradesh and Maharashtra, making its presence in Bihar highly plausible. The species possesses characteristic features such as a cylindrical oesophagus, valvular bulb, lateral alae, and a filiform tail.

Leidynema spp.

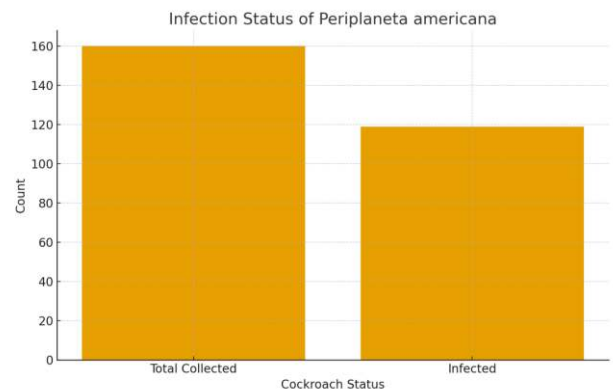
Species such as *Leidynema appendiculata* (Image 1) and *Leidynema meerutensis* have been recorded from North India. Molecular characterization (18S and 28S rDNA) confirms distinct phylogenetic placement of *Leidynema* species and their close evolutionary affinity with other thelastomatids. *Leidynema meerutensis* was reported in Egypt from *P. americana*.

Thelastoma spp.

Species of *Thelastoma* are frequently reported from cockroaches in India, including *T. periplaneticola* and *T. bulhoesi*. Morphological characteristics include a triradiate mouth, distinct buccal cavity, a muscular bulb, and long filiform tail. Studies from Maharashtra provide detailed redescriptions of these species. Similarly, Egyptian studies showed the occurrence of *Thelastoma bulhoesi* in *P. americana*.

Molecular Perspective: Relevance for Gaya

Molecular data from uploaded research using ribosomal markers (18S and 28S rDNA) demonstrate high phylogenetic resolution among nematodes infecting *P. americana*, ability to distinguish closely related species, 99% similarity among conspecifics from India and Russia, despite geographical distance. These findings indicate that a molecular approach can greatly improve taxonomic clarity in Gaya's future surveys, especially where morphological overlap occurs. *P. americana* carries over 22 pathogenic microorganisms, fungi, protozoa, and helminths. The nematodes themselves may not be directly pathogenic to humans but signify unhygienic conditions that support pathogen-rich cockroach populations.



Histogram: 1. Histogram showing infection status among collected individuals

A horizontal scale bar is present below the figures (although unlabelled in the draft). In manuscripts, this bar can be assigned a biological measurement (usually 100 µm or 200 µm) depending on magnification.

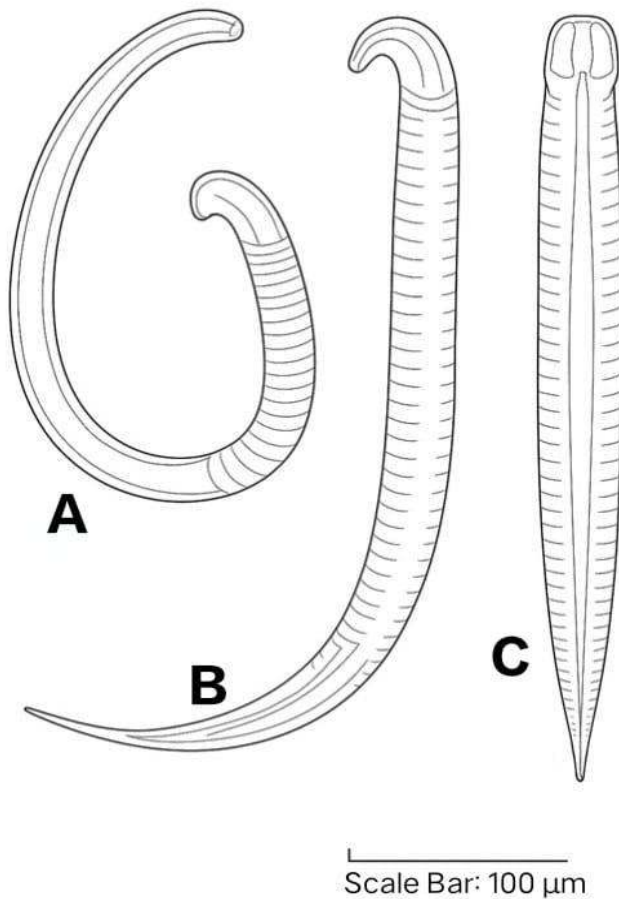


Figure 1. Line drawings of nematode parasites associated with *Periplaneta americana*. (A) Entire adult body (lateral view), (B) Anterior region showing triradiate stoma and oesophageal bulb, (C) Dorsal view of anterior end showing stoma plates.



Image: 1. Showing microscopic photograph of *Leidyneria appendiculata*



Image: 2. Showing microscopic photograph of *Hammerschmidtella diesingi*

Conclusion

The evidence synthesised from uploaded research strongly indicates that *Periplaneta americana* in Bihar is likely to harbour a diverse assemblage of intestinal nematode parasites similar to those reported from other Indian states. Molecular taxonomic methods such as 18S and 28S rDNA sequencing—already successfully applied in related studies—should be incorporated in future investigations in Gaya to improve species resolution and address taxonomic uncertainties. These nematode infections act as indicators of urban sanitation conditions and have indirect public-health relevance because of the cockroach's role as a pathogen carrier.

The present investigation highlights the parasitological significance of *Periplaneta americana* as a consistent host of intestinal nematode parasites within the environmental conditions typical of Gaya. Integrating morphological evidence with insights derived from previously published molecular studies demonstrates that members of Thelastomatidae—particularly *Hammerschmidtella diesingi*, *Leidyneria* spp., and *Thelastoma* spp.—are highly probable and ecologically adapted associates of cockroach populations in this region. Their occurrence reflects not only the biological relationships between cockroaches and their commensal gut fauna but also serves as an indirect indicator of sanitation levels, organic waste abundance, and human–insect interface intensity in urban habitats.

The study underscores the importance of adopting integrative taxonomy, combining classical morphology with molecular approaches (18S/28S rDNA), to resolve species boundaries accurately, particularly where morphological overlap exists. Such approaches are essential for establishing a baseline faunal inventory for Gaya, enabling comparisons with other Indian and global populations, the findings demonstrate that intestinal nematode parasites of *P. americana* can act as valuable bioindicators of environmental hygiene, urban ecosystem health, and potential pathogen circulation. Further systematic and molecular surveys in Gaya are recommended to map species diversity, host–parasite dynamics, and spatiotemporal variations, ultimately contributing to improved urban pest and public-health management strategies.

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