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RESEARCH PAPER

Morphological Redescription of Heterakis gallinarum in Chicks

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Abstract

Parasitic nematodes are among the most common helminths affecting poultry and are responsible for reduced growth, poor feed utilization, and increased susceptibility to disease in chicks.Heterakis gallinarum is a common intestinal nematode of domestic and wild galliform birds and is of considerable, veterinary and parasitologically important. The present study was conducted to study the presence of H. gallinarum in farms of local area.It is based on the examine of morphological characteristics of nematodes recovered from caeca of infected chicks and to facilitate their identification using standard taxonomic features. Specimens are collected naturally from the infected chicks, cleaned, preserved and examined under light microscope. This observation is based on external and internal characteristics, including body shape, body size, body length and width, posterior and anterior ends and reproductive organs. Morphometric measurements were recorded and compared with previously published descriptions to confirm the taxonomic identity of the parasite. The study provides updated morphological observations and morphometric data that contribute to the accurate identification and characterization of H. gallinarum .The findings contribute to a better understanding of nematodes diversity in poultry and may assist in developing effective control and management strategies to improve poultry health and productivity.

KEYWORDS:
Nematodes, Parasites, Chicks.

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1. Introduction

Parasitic nematodes constitute an important group of helminths affecting domestic and wild birds, with infections capable of influencing host health, growth, productivity and overall poultry performance. Among the gastrointestinal nematodes of birds, members of the genus Heterakis are particularly important because they commonly inhabit the caeca of galliform hosts. *Heterakis gallinarum* (Schrank, 1788) is widely recognized as the caecal worm of domestic fowl and has been reported from a variety of gallinaceous birds. The species has a broad geographical distribution and occurs in both domesticated and free-ranging avian populations.

Heterakis gallinarum belongs to the family Heterakidae and is characterized by a relatively small, stout nematode body, a distinct cuticle and lateral alae. Adult worms reside predominantly within the caeca of their avian hosts. The parasite exhibits marked sexual dimorphism, with females generally begin larger than males. Important morphological characters used for its identification include the structure of the anterior end, oesophagus bulb, lateral alae, cervical papillae, position of the vulva , form of the posterior extremity, pre-anal sucker and arrangement of caudal papillae in males, together with the form and size of the spicules. The eggs are typically oval, thick-shelled and smooth, providing additional characters useful in parasitological identification.

The taxonomic identification of *H. gallinarum* is principally based on a combination of morphological and morphometric characteristics. Although the general appearance of the species is distinctive, certain members of the genus Heterakis possess overlapping morphological features. In particular, females of closely related species may be difficult to distinguish solely on the basis of external morphology. Consequently, detailed examination of both anterior and posterior regions, reproductive structures

and morphometric parameters is important for reliable species determination. Recent investigation have therefore combined conventional microscopy with advanced approaches such as scanning electron microscopy and molecular markers to improve species identification and resolve taxonomic relationships within the genus.

Previous investigations have documented the occurrence and morphology of *H. gallinarum* in domestic fowl from different geographical regions. Morphological studies from India have described characteristic features of the species and compared body dimension, tail length, spicule characteristics and other diagnostic structures with earlier descriptions. Such investigations have demonstrated that minor variations in morphometric values may occur among populations from different localities, while the principal diagnostic features remain useful for species identification.

More recently, a detailed investigation from the Kashmir Valley examined *H. gallinarum* in domestic fowl using light microscopy and scanning electron microscopy, along with molecular characterization based on the ITS1-5.8S-ITS2 region of ribosomal DNA. The study demonstrated characteristic male features including caudal alae, a pre-anal sucker, caudal papillae and unequal spicules, while females were characterized by the position of the vulva, vaginal features and a pointed posterior end. Molecular analysis further supported the identification and showed that molecular markers can complement morphological examination in distinguishing *H. gallinarum* from related Heterakis species.

Despite the availability of earlier descriptions, continued morphological examination of parasite populations from different hosts and localities remains relevant. Geographic variation, differences in host age, preservation methods and specimen condition can influence observed morphometric values. Furthermore, accurate morphological characterization provides the foundation for subsequent taxonomic, ecological, epidemiological and molecular investigations. A detailed redescription is therefore useful when specimens recovered from a particular host population show measurable differences from previously documented material or when updated morphological observations are required.

Chicks and young domestic fowl can serve as suitable hosts for studying the occurrence and morphological characteristics of gastrointestinal nematodes. Examination of *H. gallinarum* recovered from chicks can provide information on its diagnostic morphology and morphometric variation within the studied host population. Such information may also contribute to a better understanding of the parasite's occurrence in poultry and provide comparative material for future taxonomic and parasitological investigations.

The present study was therefore undertaken to provide a detailed morphological redescription of *H. gallinarum* in chicks. Particular emphasis was placed on the external morphology, sexually dimorphic characters, anterior and posterior structures, reproductive features and morphometric measurements of the recovered specimens. The observations were compared with previously published descriptions to assess the conformity and variation of the present specimens and to strengthen the morphological basis for their identification.

Some of the early researches conducted earlier on *H. gallinarum* all over India during the period of 100 years are - a study by **Saroj Kumar, Rajat Garg, Hira Ram, P.S. Maurya, and P.S. Banerjee** in 2015 in poultry farms of Uttar Pradesh and Uttarakhand, India.

Another study by **C. Sreedevi, Ch. Jyothisree, V. Rama Devi, and colleagues in 2016** examined the seasonal prevalence of gastrointestinal parasites in desi fowls in Andhra Pradesh.

A study conducted by **Ananda K. Javaregowda, B. Kavitha Rani, and Suresh Patel Revanna in 2016** investigated gastrointestinal parasites in backyard chickens in the Shimoga region.

Another study by **Ishrat Ara, Humira Khan, Tanveer Syed, and Bilal Bhat in 2021** in Kashmir, India.

More recently, a study conducted in **2021 in Vishakhapatnam district of Andhra Pradesh** examined 300 gastrointestinal samples from chickens to identify helminth parasites.

The study was carried out in the subtropical and humid zone of Jammu, northern India. The gastrointestinal tracts of 125 free-ranging/backyard chickens were examined by necropsy.four nematode species, including *Heterakis gallinarum*, and four cestode species were recorded. **Katoch et al. (2012) - Jammu, India.**

A study where researchers examined 2,290 faecal samples from backyard chickens in the mid-hill region of Meghalaya. Birds were divided into three age groups: <8 weeks, 8-28 weeks and >28 weeks. Samples were examined by flotation, sedimentation and modified McMaster techniques. **Das, Laha & Doley (2022) - Meghalaya, India.**

The work was conducted by the Department of Parasitology, College of Veterinary Science, Rajendra Nagar, Hyderabad. It reports natural infection with *Heterakis gallinarum* in backyard poultry along with *Dispharynx spiralis.* The paper was received in 2015 and appeared in the 2016 issue of Journal of Parasitic Diseases. **Sreenivasa Murthy & Panda (2016) - Hyderabad, India.**

This is the most important additional reference for your particular research topic. The researchers examined 400 gastrointestinal tracts of domestic fowl over two years, of which 90 were infected with *H. gallinarum*, giving a prevalence of 22.5% and a mean intensity of 26.83 worms. **Ara et al. (2024) - Kashmir, India.**

The researches examined 345 Gavran(desi) chickens during an annual cycle from June 2012 to May 2013. A simple salt-

flotation method was used to detect helminth infections. Overall helminth prevalence was 84.05%, with the highest prevalence during summer (93.09%), followed by the rainy season (85.27%) and winter (74.18%). **Naphade & Chaudhari (2013) –**

Maharashtra, India.

The study was conducted in Ramanthapuram district, Tamil Nadu, India. It concerned a backyard/community flock consisting of 21 guinea fowls, 8 turkeys and 43 desi chickens. During December 2019, which was the rainy season, acute the guinea fowls; approximately 15 five-month-old guinea fowls died within one week. **Vijayalingam, Rajesh & Latchumikanthan (2020).**

Overall studies conducted between 2015 and 2021 have consistently reported that *Ascaridia galli, Heterakis gallinarum, and Capillaria* species are the most common nematodes affecting chickens.

Material and Methods

Chicks are collected from the farms of Baraut are sourced for local market or farms showing the poor growth, diarrhea or sudden deaths. Materials which are required for the experiment are - Forceps, 0.85% saline solution, 70% ethanol (60-70℃), 5% glycerin, 5-10% formalin or hot AFA (alcohol-formalin-acetic acid), 5% formalin or PVA (polyvinyl alcohol), lactophenol or glycerin for light microscopy, compound microscope, centrifuge, image analysis software, micropipettes (10-1000 micro litre), glass slides/cover-slip, petri dishes, staining jars, PPE, biosafety level 2 protocols, autoclave waste and camera lucida.

The methodology to identify the *H. gallinarum* includes a series of steps. These steps are perform in sequence with safety and measures.

1. **Ethics and Prep** - Pick 20-50 sick chicks (2-12 weeks old)from farms. Check for worm eggs in poop using a simple float test. Kill chicks kindly (neck snap or CO_2 gas). label each with age, sex, and farm information.
2. **Open and collect worms -** Cut open the chick on a clean table under a low-power microscope. Check gut parts: throat, crop, stomach, small gut, ceca and large gut. Wash each part with salt water (use 200-500 ml) over fine sieves (100-200 micron holes) to catch worms. Count worms roughly (males curve, females straight). keep live ones cool in salt water.
3. **Fix Worms -** Put worms in hot (70-80℃) 70% alcohol or formalin for 1-2 days to kill and keep shape. Move to alcohol with glycerin for storage in labeled bottles. Use hot mixes for baby worms to stop shrinking.
4. **Make Clear and Mount -** Soak worms 1-3 days in lactophenol (mix of acid, phenol, glycerol, water) to see inside clearly. For slides: dry in alcohol steps, clear in xylene, glue under glass with balsam. Put males on back (see spikes), females on side (see egg tube). use one slide per type.
5. **Check and Measure -** Use a microscope with a ruler in the eyepiece (calibrate with stage ruler). look low power first (4x-10x), then high (40x-100x oil). measure 20-30 worms each.
6. **Take Photos -** Use a camera on the microscope. Snap front (lips), middle (nerve ring), sex parts (spikes/eggs), and tail. Try 3D light if you have it. For fancy surface views, use SEM machine if available (fix extra, coat in gold).
7. **Identify Worms -** Match sizes and shapes to books like CIH keys or poultry worm guides. Draw pictures or use computer software. List how many chicks had worms and average per bird.
8. **Analyze Data -** Use Excel for averages and charts. Compare by farm or age. Add DNA tests if you can. Clean tools and throw away waste safely. Put all photos/tables in your project book.
9. Figure draw through camera lucida.

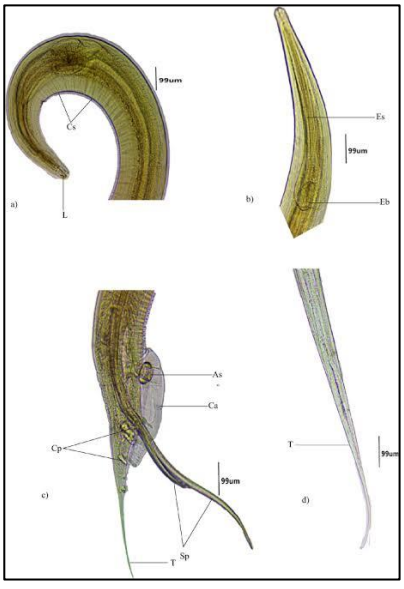

Fig 1: Microscopic image of Heterakis gallinarum.

Results

The examination of the collected specimens revealed the presence of a small, whitish nematode inhabiting the caecal region of the chicks. Based on the general morphology and the characteristic features of the anterior and posterior ends, the specimens were identified as *Heterakis gallinarum*(Schrank, 1788). Both male and female specimens were recovered, showing distinct sexual dimorphism.

The adult worms possessed an elongated, cylindrical body with a tapering anterior and posterior extremity. The cuticle showed fine transverse striations, while lateral alae were distinctly visible along the body. The anterior extremity was provided with three prominent lips surrounding the mouth. The oesophagus consisted of an anterior muscular portion followed by a distinct posterior bulb containing a valvular apparatus. These features were consistent with the diagnostic morphology of *H. gallinarum*.

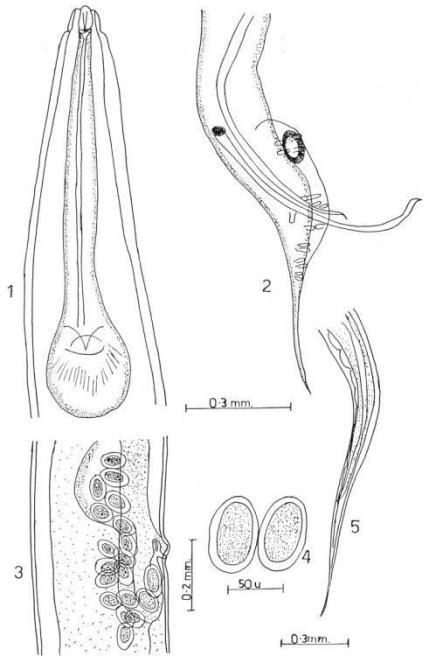

***Fig 2: Heterakis gallinarum* (1) Anterior end of male, (2) Posterior end of male showing spicules and anal sucker, (3) Vulval region, (4) Eggs and (5) Posterior end of female**

Male Morphology

The male specimens were comparatively smaller than the females. The posterior end was distinctly modified and possessed well-developed caudal alae and a prominent pre-anal sucker. Twelve pairs of caudal papillae were observed around the posterior region. The cloacal opening was situated near the caudal extremity, and two unequal spicules were present. The unequal nature of the spicules was particularly useful for distinguishing *H. gallinarum* from some morphologically similar species.

The body length of the examined specimens ranged from 4.7 to 13.0 mm, while the body width varied from 0.27 to 0.35 mm. The oesophagus measured 0.75-1.42 mm in length. A distinct precloacal sucker was observed in the male specimens, measuring 0.15-0.22 mm in diameter. The caudal alae were well developed and measured approximately 0.05-0.055 mm.

The male specimens possessed a pair of unequal spicules, which is a characteristic feature of *H. gallinarum*. The right spicule measured 0.40-0.70 mm, whereas the left spicule was longer, measuring 0.83-1.90 mm. The marked difference in the length of the two spicules, together with the presence of the precloacal sucker and caudal alae, supported the morphological identification of the the specimens as *Heterakis gallinarum.*

Table 1: Measurement chart of male Heterakis gallinarum

Body parts	**Measurement (mm)**
Length	4.7 to 13.0
Width	0.27 to 0.35
Oesophagus	0.75 to 1.42
Precloacal sucker	0.15 to 0.22
Caudal alae	0.05 to 0.055
Spicules	Right- 0.40 to 0.70 Left - 0.83 to 1.90

Female Morphology

The morphological examination of the female specimens of *Heterakis gallinarum* recovered from chicks revealed a slender, elongated, cylindrical body with characteristic morphometric features. The body length of the examined specimens ranged from 8 to 15 mm, while the body width varied between 0.3 and 0.5 mm.

The oesophagus measured 0.7-0.8 mm in length. The vulva was situated at a distance of 3.5-4.7 mm from the anterior end of the body. The posterior end was characterized by a distinct tail measuring 0.8-1.0 mm in length.

The observed morphometric characteristics were consistent with the general morphological features of female *Heterakis gallinarum*. The combination of body dimensions, esophageal length, position of the vulva, and tail length provided useful morphological criteria for the identification and redescription of the species in chicks.

Table 2: Measurement chart of female Heterakis gallinarum

Body part	**Measurement (mm)**
Length	8 to 15
Width	0.3 to 0.5
Oesophagus	0.7 to 0.8
Vulva distance	3.5 to 4.7
Tail	0.8 to 1.0

Discussion and Conclusion

The present provides a morphological redescription of *Heterakis gallinarum* recovered from chicks, based on the morphological and morphometric characteristics of both male and female specimens. The observed measurements also showed variation in body dimensions between individual specimens, which may be associated with differences in developmental stage, maturity, nutritional condition or natural intraspecific variation.

The male specimens measured in 4.7-13.0 mm in length and 0.27-0.35 mm in width, whereas the females were comparatively longer, measuring 8-15 mm in length and 0.3-0.5 mm in width. Thus, the present observations demonstrate clear sexual dimorphism, with females generally larger than males. The oesophagus measured 0.75-1.42 mm in males an0.7-0.8 mm in females. Presence of a distinct oesophageal region is an important morphological characteristics of *H. gallinarum.* Previous morphological investigations have also described a well-developed oesophageal bulb with a valvular apparatus in this species.

The posterior morphology of male specimens provided particularly important taxonomic characters. The precloacal sucker measured 0.15-0.22 mm, while the caudal alae measured 0.05-0.055 mm in the present material. The male possessed two unequal spicules, with the right spicule measuring 0.40-0.70 mm and the left spicule 0.83-1.90 mm. The unequal nature of the spicules, particularly the longer left spicule, is an important diagnostic feature of *H. gallinarum.* These characters are useful in differentiating *H. gallinarum* from morphologically similar members of the genus *Heterakis*.

Female specimens in the present study measures the vulva distance of 3.5-4.7 mm form the anterior end, indicating its anterior-to-middle position along the body. The female tail measured approximately 0.8-1.0 mm and showed the characteristic tapering posterior region. The position of vulva and the pointed posterior end are useful characters for morphological identification. Previous studies have similarly reported the vulva as being approximately in the middle region of the body and described of a long, pointed female tail.

Overall, the combination of body size, sexual dimorphism, oesophageal morphology, precloacal sucker and caudal alae in males, unequal spicules, and the position of the vulva and tail morphology in females supports the identification of the examined nematodes as *Heterakis gallinarum.*

Conclusion

The present investigation confirms the characteristic morphological features of *Heterakis gallinarum* in chicks. The study demonstrated distinct sexual dimorphism, with females attaining greater body length and width than males. The presence of unequal spicules, precloacal sucker and caudal alae in males, together with the characteristic vulval position and pointed tail in females, provides useful diagnostic evidence for species identification. The recorded morphometric ranges contribute additional information on the morphological variability of *H. gallinarum* and may be useful for comparison with specimens from other geographical regions and avian hosts.

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