Research Article

Parasitoses and Histopathological Consequences of *Trichuris trichiura* (Nematoda: Enoplida) in Rodents, *Rattus rattus* (Mammalia: Rodentia)

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ABSTRACT

The parasites are helpful in providing information to population bioecology and pathogenesis to respective hosts. Furthermore, the parasites acquire a variety of specialized traits and life-historic strategies which enable them to take possession of hosts. The yesteryears extensive study focused on the epidemiology of whipworms in rodents population, more especially wild rats, *Rattus rattus* (Mammalia: Rodentia) from urban localities of eastern Uttar Pradesh, India. During investigation adult enoplid roundworms, *Trichuris trichiura* (Nematoda: Enoplida) were recovered from small intestine. However, the cluster of bipolar eggs and substantial pathological changes observed in hepatic tissue through histology. The pattern of whipworms population biology in the rodents during study reflected that more than 50% rats' population had whipworms infection. The nemic distribution dynamics and parasitoses based on Poisson series was statistically found to be over-dispersed in rodent hosts, so that the growth, development and reproduction of respective hosts affected adversely. Therefore, authors suppose to propose the awareness among societies about parasite diversity in naturally inhabiting fauna perspective to hygiene, health, economy and sustainable development.

Key words: Parasitoses, *Trichuris* sp., Histopathology, Bioecology, *Rattus rattus,* FMR.

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INTRODUCTION

The parasite is a pathogen that simultaneously injures and derives sustenance from its host. Although Parasitology had its origins in the animal sciences, but it is an interdisciplinary field today, greatly influenced by Microbiology, Immunology, Biochemistry and allied branches life sciences.[1] The union of parasite and host is usually an elaboration compromise between extracting sufficient nourishment to maintain and propagate itself and not impairing too much the vitality or reducing the number of its host which is providing it with a home and free ride. Although most parasitic infections are more prevalent in tropics, many hosts in temperate and subtropical areas also become infected.[2] To lead a parasitic mode of life, the parasites have adapted themselves in such a way as to survive and adjust itself with the body environment of their host. Adaptation is a dynamic process of adjustment with the new environment for establishment, self regulation, self preservation and race continuation.[3] The study of contact, interaction and relationship between the host and the parasite is known as host parasite relationship and with pathological study of host tissue is known as histopathology. Parasitism is one of the symbiotic associations in the living organism based on the utilization of microhabitat for food, shelter and reproduction.[4] The sources of parasitic infection includes man, animal, vectors, contaminated soil and water, raw or undercooked meat, etc.[5] The soil polluted with human excreta containing eggs of the parasites can act as an important source of infection, e.g., hookworm, *Ascaris* sp., *Strongyloides* sp. and *Trichuris* sp.[4,6,7]

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The mechanism of entry and the establishment of a parasite with in a particular host vary widely from species to species in different animals. The degrees of response by each host to parasites, which making tissue contact are related to nature of invasive tissue and also the intimacy of the stages of development of living organism, either an adult or larva.[6,8] At cellular level when parasites make contact with a host, the host reacts by bringing in to action as cellular and serological reactions.[9] It is thought that the host is able to distinguish between self and non self or foreign material, at a molecular level, but the mechanism of this recognition may be take place at the surface of the susceptible cells or recognizing cells.[10,11] Linnaeus was the first to describe the worm, *T. trichiura*. The trichuriasis or trichocephaliasis or trichocephalosis or whipworm infection in human is a major problem in the area where the wild animals have such nemic infection and acting as shared indicator.[12] Therefore, the present investigation taken in consideration to work out histopathological and distribution aspects of *Trichuris* sp. in the urban localities for health, mankind, sustainability and eco-societal welfare.

MATERIALS AND METHODS

The worms recovered from the gut of *Rattus rattus* were washed in lukewarm water and processed for morphotaxonomy.[13] The generic diagnosis of collected roundworms was based on Yamaguti.[14] The liver tissue of infected wild rats was fixed in picroforma or Bouin's fluid for histopathological investigation and processed for paraffin microtomy after standardized laboratory protocol.[15] The microphotographs were captured by MOTIC image analyzer using Nikon trinocular computerized micro-photographic unit and Biovis image plus software. All the measurements were given in micrometers (µm). The nemic prevalence %, female to male ratio (FMR) and pattern of infection distribution were calculated by advanced biostatistical tools.[16]

RESULTS

The roundworms isolated from the intestine of wild rats, *R. rattus* (Mammalia: Rodentia) from the sites of investigation were characterized as *Trichuris* sp. (Nematoda: Enoplida) by typical whip like body, cuticle with fine transverse striations, narrow cephalic end, indistinct oral papillae and dorsally curved caudal end with subterminal anus. The male worms with slender well cuticularized, distally sharp and pointed spicules, however, females had non-protrusible muscular vulva and long monodelphic uterus. The infection in liver was identified by the presence of numerous creamish-white patches and cysts all over the surface. The histopathological analysis indicated penetration of liver across the intestinal wall by adult worms. The mature female worms laid their eggs in the intracellular and intercellular hepatic spaces (Figure 1). The eggs were lemon shaped, with two polar plugs and about 47µm long and 21µm in widest diameter.

The morphological studies were carried out in 19 adults of *Trichuris* sp. from different hosts of same geographical regions. The females of *Trichuris* sp. showed a total length of 30000–42000µm (37000µm) while the vagina length ranged from 690–830µm (750µm). The morphological study revealed a vulva with a round and circular margin without spines and appeared smooth or covered with only small cuticle bosses. The vagina showed short and, sometimes, slightly convoluted in several loops and a small egg chamber was observed in front of the vulva (Figure 2).

The males of *Trichuris* sp. showed a spicule length ranged from 4000–5150µm (4600µm) with 300–550µm (400µm) diameters. The males displayed a spherical bulge in the distal part of the spicule sheath which was covered with spines that were longer than those in the rest of the sheath (Figure 3) Out of the total infected male hosts, 61% were infected by the male nematodes and 53.3% by female nematodes. The findings were also provided evidence of the highest female male ratio (FMR) of roundworms during spring (7.38) than in winter (5.11).

DISCUSSION

The soil-transmitted helminth (STH) *Trichuris trichiura* infects around 465 million people worldwide being

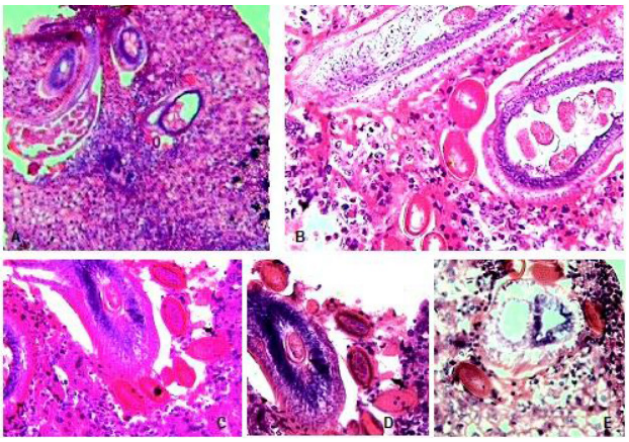

Figure 1: Histology of infected liver of wild rat showing the lemon-shaped bipolar eggs (*in situ*) and status of tissue damage.

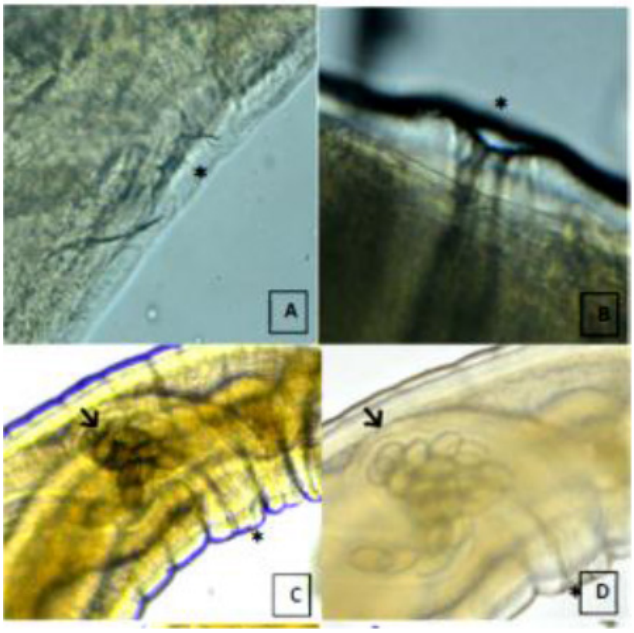

Figure 2: Females of *Trichuris* sp. recovered from gut of wild rat, *Rattus rattus*.

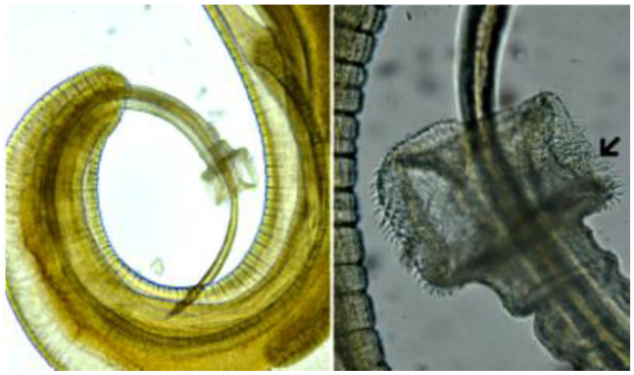

Figure 3: Males of *Trichuris* sp. recovered from gut of wild rat, *Rattus rattus*.

especially prevalent where hygiene and sanitation are poor.[17] Here we present the findings of *Trichuris* worms derived from rats of urban locality in Prayagraj, Uttar Pradesh, India (formerly known to be Allahabad). We observed that the perisinusoidal spaces and spaces between reticulo-endothelial and hepatic cells increased in the infected liver than the non-infected host tissue.[18,19] Knight cited more than 23 species of *Trichuris* been 50 described from ruminants. The *Trichuris* sp. is traditionally a parasite of the cecum of ovine but has been isolated from several animal hosts also.[20-22] Females of whipworms are more difficult to differentiate than males and some authors suggested that the structure of vulva could be used for species differentiation stated that there are two different types of vulva in trichurid females with and without spines.[23-26] The specimens of *Trichuris* from rats were hard to identify. The spicule length has been considered as the main criterion to differentiate *Trichuris* species.[27] From the literature, the length of spicule for *T. discolor* has been reported as 1700 µm,[28] 1700–2300 µm,[29] 1720–1804 µm[30] 1500–2002 µm,[31] or 1750–1990 µm.[32] Furthermore, Knight[20] and lately Rickard and Bishop[25] proposed a key to species of *Trichuris* based on spicule length greater than 5000µm (*T. ovis* = 5690 µm;[33,34] *T. tenuis* = 7200 µm)[33] or spicule length less than 5000µm (*T. discolor, T. rhinopiptheroxella*.[22] *T. trichiura* and *T. suis)*.[7] The five years consecutive investigation indicated that the larger the rats, greater the infection as published earlier.[35] The reported study also described younger rats to be more resistant than the older ones to infections by *T. trichiura*.[36] The correlation of feeding habits with size of the host played a major role in heavier infection due to greater intake of resources, potentially capable of exposing these hosts which played a major role to more infectious stages of parasites through incidental ingestion.[37,38] The agreement of nemic distribution in rat population was statistically found to be significant on Poisson series (p<0.50), thereby indicating that nemic population were found to be over-dispersed in hosts. The nemic prevalence in the present investigation was found to be significantly higher than the earlier reported cases of prevalence of trichuriasis among human participants was 46.2% however 46% pigs sampled were found to be infected.[39]

CONCLUSION

In conclusion, we have determined morpho-biometrically the species of *Trichuris* as *Trichuris trichiura* from rats of urban locality from northern India. These species have studied and showed remarkable loss to hepatic tissue in the infected hosts. The population of the target species in the sensitive hosts over-dispersed based on Poisson distribution and affecting more than 50% of the hosts utilizing the same locality. The authors wish to suppose and proposed the further studies should be carried out in order to clarify this situation based on the present investigation.

Significance' statement

The utmost care should be taken to educate people regarding the ill effect of such parasitic infections with zoonotic potential and health problems.

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CONFLICT OF INTEREST

The author claims no conflicts of interest because none financial support was received from any government, non-government agency or organization to conduct this research work.

ABBREVIATIONS

FMR: Female Male Ratio; **STH:** Soil Transmitted Helminthes.

SUMMARY

The epidemiology of *Trichuris* sp. in rats' population from urban area of eastern UP, northern India worked out during present study. The investigation reflected occurrence of adult enoplids population in small intestine of hosts. However, bunch of bipolar eggs and remarkable pathological alterations was noticed in liver of hosts. The population ecology showed that over 50% of hosts had nemic infection and statistically found overdispersed among hosts population utilizing same localities.

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