TRICHURIS TATERI SP.N. (NEMATODA: TRICHURIDAE) FROM INDIAN GERBIL AND RAT (RODENTIA: MURIDAE) IN KARACHI, ITS SUBURBS AND SUJAWAL

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خلاصہ

جینس *Trichuris* کی نئی نوع *Trichuristateri* پاکستان میں indian gerbil اور rat کی چھوٹی اور بڑی آنت سے دریافت کی گئی ہے۔ یہ نئی نوع *Trichurismusseri* سے جسامت میں بڑی جبکہ *Trichurismallomyos* سے جسامت میں چھوٹی ہے۔ یہ نئی نوع کراچی اور اس کے suburbs اور Sujawal سے پہلی بار دریافت کی گئی ہے۔ یہ نئی نوع spicular کی لمبائی (0.96-1.76)، vulva کے کھلنے کی سمت، جسم کے طول و عرض میں فرق، convulated tubular ٹیسٹس، vas deferens اور seminal vesicle کی وجہ سے اسے دوسری انواع سے مختلف بنا دیتی ہے۔

Abstract

Representative of Genus *Trichuris* Roederer, 1761 (Nematoda: Trichuridae) parasitic in the Indian Gerbil (*Tateraindica*) and rat (*Rattusrattus*) from Karachi and its suburbs as well as Sujawal is being described in detail. The new species *Trichuristateri*is readily separated from *Trichurismusseri*in having a relatively larger body but smaller as compared to*Trichurismallomyos.*

The species is new and is characterized by the range of spicular length 0.96-1.76 (Twenty five specimens studied), upward direction of vulva opening in females, difference in general body dimensions, convoluted tubular testis, vas deferens and seminal vesicle.

Keywords: Parasite of zoonotic importance, Indian gerbil, commensal rodents, Karachi suburbs, Sujawal.

Introduction

Trichuris often called whipworm are parasitic nematodes from the roundworm family. In its cycle the eggs are first swallowed by host, they usually reach the small intestine and duodenum where they hatch and travel to large intestine cecum (Ransom, 1911). Here they feed on the blood vessels situated in the cecum. Later the larvae leave cecum and lay thousands of eggs, which are set free through the feces. The series of steps from egg ingestion to the release takes almost twelve weeks. Released eggs are eventually ingested by another host. The larvae can survive without a host for 6 months.

In Pakistan rodents helminth parasites are poorly known and have not been completely (Khatoon *et al.*, 2004). In order to gain an insight into the composition and diversity of helminth community in rodents in Pakistan a survey was carried out on rodents parasites in Karachi and its suburbs along with Sujawal Sindh, Pakistan.

The genus *Trichuris* Roederer, 1761 species are of common occurrence, parasitizing vertebrate hosts including humans and small mammals. These are reported from various countries including India but none from Pakistan. Present species is being first time reported from this locality and *Tateraindica* (Indian gerbil) is the main host while *Rattusrattus* (rat) being other host of this particular genus.

Indian gerbil (*Tateraindica* Hardwicke, 1807) distribution covers a large area from the Northern Arabia through Iran, Afghanistan, Pakistan, India and Sri Lanka (Harrison and Bates, 1991). Nematodes of the genus *Trichuris* Roederer, 1761 are parasitic in the large intestine of various mammals including mice (Anderson and Bain, 1982). Pakistan is among one of the countries having high diversity of rodents with more than 43 different species, mostly mice and rats but also involve giant flying squirrels, porcupine and dessert gerbils. Rats and mice have a wide distribution in the country. Rodents are considered as probable hosts of zoo notically important parasites (Khan, 1990). Wondifraw *et al.* (2021) stated that crop fields near forest were more vulnerable to rodent damage. Singleton *et al.* (2021) suggested that in Asia small scale farmers are more prone to rodents harm as they badly effect food security whereas new strategies are being considered such as fertility control.

Trichuris Roederer, 1761, are without restraint the most recognized nematode parasites of mammals (Feliu *et al.,* 2000; Torres *et al.,* 2011; Robles *et al.,* 2006).

Materials and methods

Seventy five species in total of *Tateraindica* (Hardwicke, 1807) were collected, 30 of them from Pipri and Landhi Rice Godowns, Karachi and 45 from Sujawal Agricultural Area, Sindh, Pakistan. One out of three *R. rattus* was found infected with three male and two female specimens.

For fixation of viscera 10% formalin was used and examined for detail study in the Parasitology laboratory. All the 78 hosts were examined, out of which 75 were *T. indica* and 03 were *R. rattus.* Hosts infected were 30 *T. indica* and 01 *R. rattus.* 253 male and 167 female specimens were recovered from *T. indica* and 02 female and 03 male specimens were recovered from *R. rattus.* Nematodes were recovered from the large and small intestines of the hosts; these were later maintained in its original state in 70% ethanol, cleared in lacto-phenol and studied using a light microscope. Diagrams were made with the help of camera Lucida. A few specimens were prepared for the study of surface ultra structure, live specimens were fixed in cold 4% glutaraldehyde in buffer (7.2) for 24 hours, then dehydrated, 'dried' mounted on stubs and coated with gold and finally examined under SEM (Khan and Bilqees, 1984). Photomicrographs were prepared through the courtesy of M.A.H. Qadri Biological Research Centre, University of Karachi, Karachi. The prevalence and mean intensity were investigated by applying the formula given by Bush *et al.,* 1997. Descriptions of both the male holotype and female allo type are given. Measurement of the para types, which include the mean and SD, in parentheses ranges are given. Unless otherwise mentioned measurements are in mm.

Voucher specimens have been placed in the Medical Zoology Laboratory, VPCI, PARC, Southern zone Agricultural Research Centre, University of Karachi, Karachi-75270, Pakistan and numbers are given.

Results and Discussion

***Trichuristateri*sp.n.**
(Figs. 1-10)

Main host:	*Tateraindica* (Hardwicke, 1807)
Murinae:	Muridae
Other host:	*Rattusrattus* (Linn., 1758)
Site of infection:	Small intestine and large intestine
Type localities:	Pipri and Landhi Rice Godowns, Karachi Sujawal Agricultural Area, Lower Sindh
Type specimens:	Holotype male and female Allotype, MZVPCI (7 male and 5 female paratypes) from Karachi, 3 male and 3 female paratypes from sujawal
Number of specimens recovered from both hosts:	256 males, 169 females
No. of hosts examined:	78
No. of hosts infected:	31
Dates of hosts collection:	October 1990-August, 1993
Specimen numbers:	MZVPCI: 1-425
Etymology:	Species epithet is derived from the generic name of the type host

The nematodes found in the large and small intestines of the *T. indica* and *R. rattus* from both the localities are being considered as a new species of the genus. A total of 425 specimens were collected. The prevalence was 39.7% (31 infected of 78 hosts examined), and mean intensity of infection was 13.70. Minimum infection was three specimens from a host and maximum infection was seventy eight specimens from a host.

Description

***Trichuristateri*sp. n.**

General: Body small to medium size, slender, anterior $3/5^{th}$ attenuated-whip-like while the remaining posterior portions are comparatively stouter with rounded ends. Cuticle fine transversely striated with wide longitudinal bacillary bands on ventral side of esophageal region. Male worms are smaller and delicate than the female worms. Male caudal portion is mostly coiled tightly whereas in female the posterior endings are simple. Anterior region straight with simple oral opening without lips. Esophagus almost entirely muscular, simple attenuated, as long as the length of the whip, spicule single in an evaginable prepuce-like sheath, the external surface of which is spiny Bluntly rounded, slightly curved is the female posterior extremity. Vulva near the junction of the two body regions Eggs barrel-shaped with plug at each pole.

Male (Based on a holotype and 24 paratypes)

Body small to medium sized, delicate 20.1-26.3 (23.2) long by 0.025-0.031 (0.028) wide at nerve ring, width increasing posteriorly to 0.021-0.4 (0.31) at greatest width and then decreasing to 0.13-0.16 (0.15) at the terminal anal region. Anterior extremity simple without any cephalic structures, somewhat conical in appearance 0.035-0.04 (0.031) wide. Mouth opening or stoma leads into narrow, tubular esophagus, narrow muscular esophagus at the end, have direct connection with the functional intestine without any vulvar apparatus. Esophagus occupies entire length of the whip like portion about three fifth of the entire body length. Esophagus 11.5-14.6 (13.05) long and 0.02-0.05 (0.035) wide. Distance of nerve ring from the anterior end is 0.04-0.051 (0.045). Excretory pore, minute not obvious in most of the specimens 0.1-0.14 (0.12) from the cephalic extremity. Anterior genital tube totally absent. Testis confined in the posterior 1/3rd region of the body, convoluted to some extent, leads to a small vas-efferens which continues into a vas-deferens. Seminal vesicle conspicuous, leads into a cloacal tube or ejaculatory duct. Lining of the cloaca itself revertible, forming a spicular sheath, armed with fine, coarse spines. Spicular sheath 0.1-0.15 (0.125) long outside the cloacal opening and 0.035-0.04 (0.037) wide. Spicule single with blunt anterior, posterior ends 0.96-1.76 (1.36) long, 0.02-0.025 (0.022) wide. Tail absent, caudal region almost tightly coiled, cloacal opening terminal. SEM (Scanning electron micrograph) of the caudal region shows a longitudinal pattern of the cuticle. The prepuce sheath is spinose covered with fine coarse spines projecting upward. The protruded spicule has bluntly rounded end.

Female (Based on an allotype and 24 paratypes)

Body comparatively larger than the male worms, posterior 1/3rd portion much stouter than the anterior 2/3rd whip-like portion.31.88-39.86 (35.87) long by 0.02-0.049 (0.036) wide at greatest width. The anterior whip-like portion 15.45-22.50 (18.97) of the total body length. Cephalic end simple, conical in appearance devoid of lips or accessory structures. Cephalic end narrow 0.02-0.05 (0.035) wide. Distance of nerve ring 0.06-0.07 (0.065). At a distance of 0.1-0.16 (0.13) excretory pore is situated. Esophagus simple, narrow and muscular, terminated by an esophageal swelling. At the end esophagus is directly connected with the functional intestine. Reproductive system consists of a tubular ovary, much coiled, exclusively in the posterior part of the body. Uterus extends up to the posterior extremity. Oviduct U-shaped extends up to the vulva. Vulva opening situated just beneath the junction of the anterior whip-like anterior portion and the posterior stouter part of the body. Vagina small, muscular, opens to the exterior by a simple upward vulvar projection, width at the vulvar region 0.19-0.20 (0.195), cloacal opening terminal. Posterior extremity bluntly rounded with a small lobe or bi-lobed posterior ending, width at the posterior extremity 0.07-0.15 (0.11). Scanning electron micrograph of the caudal extremity shows it to be bluntly rounded with transverse cuticular striations. Eggs characteristics barrel-shaped. The eggs possess three membranes: an outer protein coat, deeply pigmented and appear brownish in color, an intermediate true shell which is transparent and internal vitelline membrane which appears to be lightly granular. The most characteristic structures are the plug-like opercular knob-like structures at either pole. The eggs measure 0.042-0.045 (0.043) by 0.019-0.02 (0.0195).

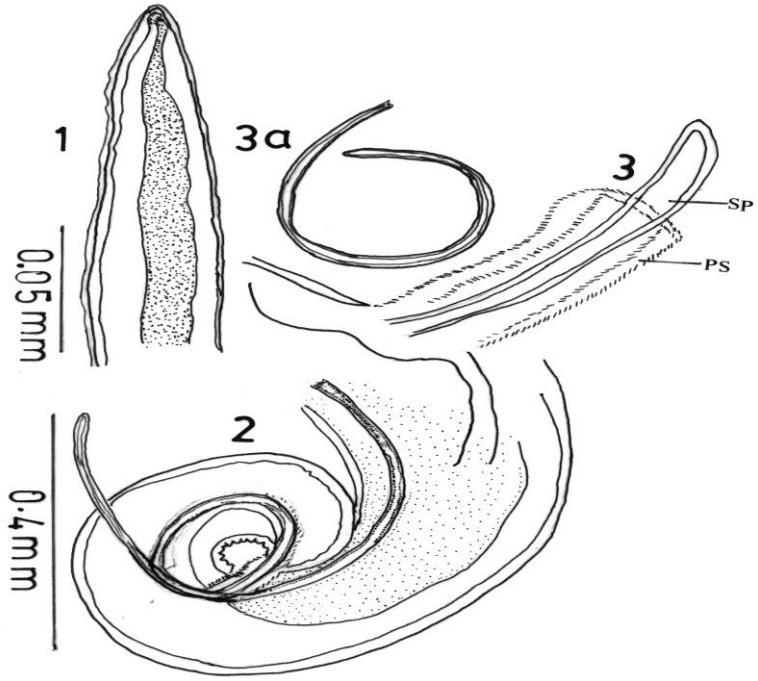

Fig. 1. Anterior portion of the male.
Fig. 2. Caudal region of the same with projected spicule.
Fig. 3. Enlarged prepuce sheath with terminal part of the spicule.
Fig. 3a. Spicule of a para-type enlarged.

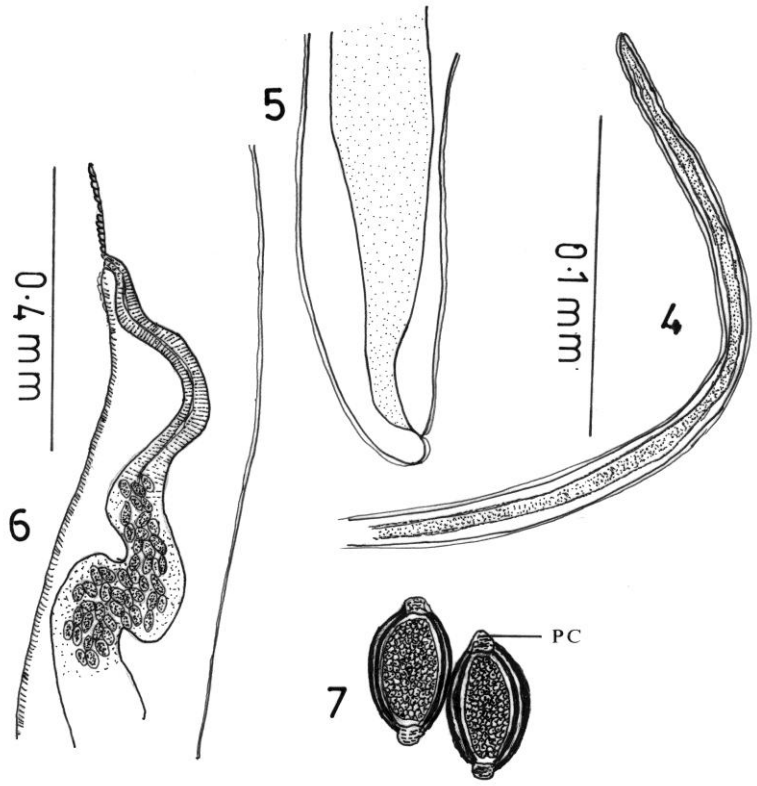

Fig. 4: Anterior region of allo-type female with part of esophagus.
Fig. 5: Caudal portion of the same.
Fig. 6: Vagina and genital opening.
Fig. 7: Barrel-shaped eggs.

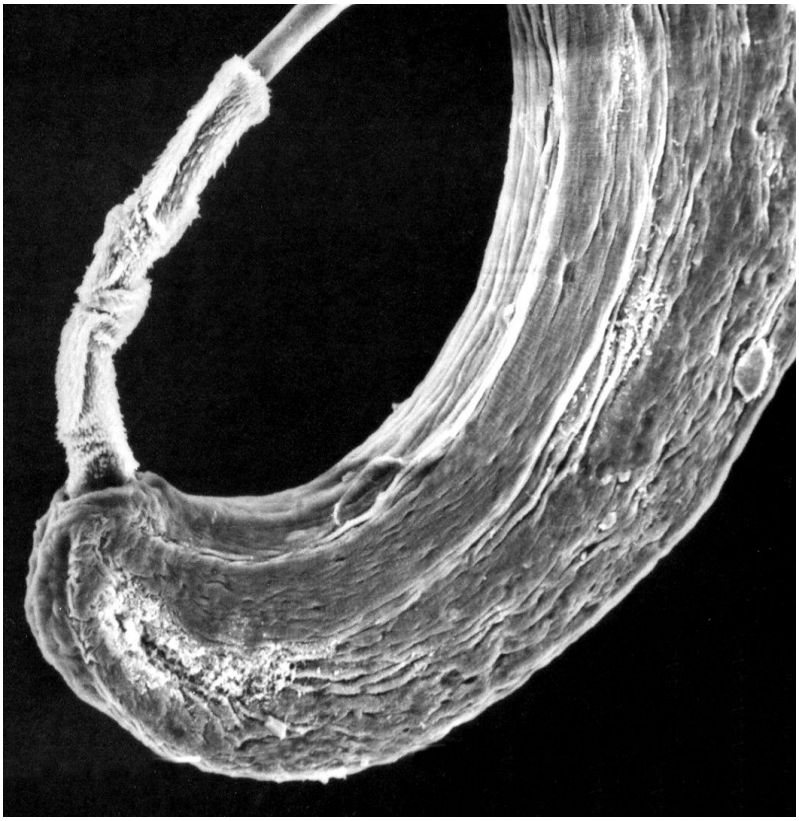

Fig. 8: Ultra structure of caudal region of male allotype with projecting spicule(350X).

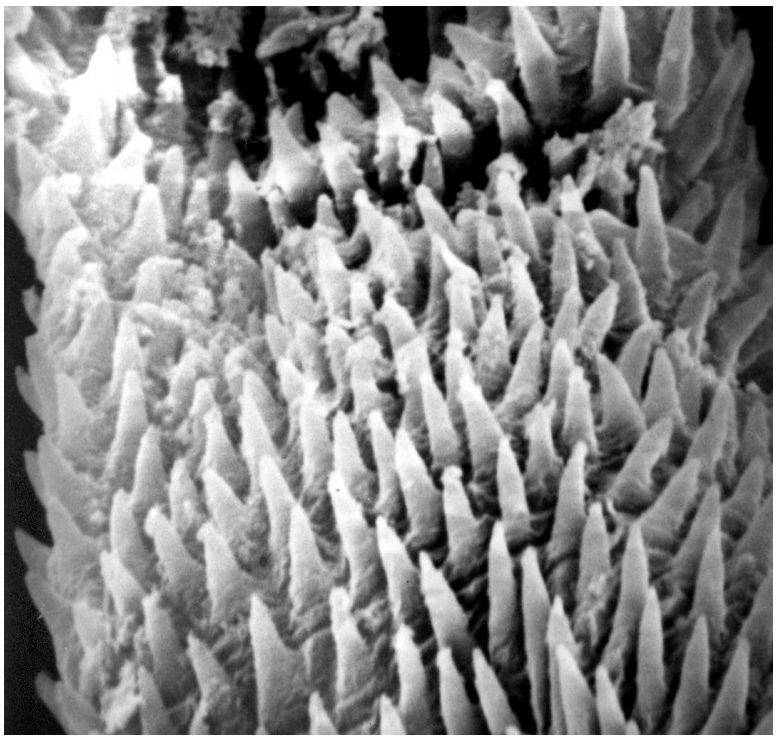

Fig. 9: An enlarged portion from the spiny prepuce sheath (5000X).

Fig. 10: Ultra structure of caudal region of female para-type (1500X).

By having body structure as anterior 3/5th attenuated whip-like while the remaining posterior portion comparatively stouter with rounded ends, spicule single in an evaginable prepuce-like sheath, the external surface of which is spiny, vulva near the junction of the two body regions. Barrel-shaped eggs with plug at each pole, the species being reported belongs to the Trichuridae family in the super family Trichinelloidae.

The specimens have posterior portion comparatively stouter, cuticle fine, transversely striated with wide longitudinal bacillary bands on ventral side of esophageal region, un-embryonated eggs in the uterus arranged in file, related the specimens to the subfamily Trichurinae which comprises of only a single genus *Trichuris* Roederer, 1761 (Anderson and Bain, 1982).

Possessing a relatively larger body size, the species in consideration is easily separated from all congeners known from murids because all have mean body length over 10 mm in males and 15 mm in females (Quentin, 1966; Bernard, 1969; Skrjabin *et al.*, 1957; Johnson, 1973; Tenora, 1969; Feliu *et al.*, 2000; Sadighian *et al.*, 1974; Ribas *et al.*, 2013; Robles, 2011; Robles *et al.*, 2014; Smales, 2013).

Main features of present specimens are spicule single in an evaginable prepuce-like sheath, the external surface of which is spiny, being readily distinguished from most members of the same genus in murids, which have dull or rounded distal end abruptly narrowed near distal end of the spicule (Robles, 2011; Robles *et al.*, 2014; Ribas *et al.*, 2013; Quentin, 1966; Feliu *et al.*, 2000; Smales, 2013).

The members of the same genus parasitic in murids, only *T. spalacis*in the mole rat, *Spalacismicrophthalmus* of Ukraine and *T. petrowi*in *Arvicolaterrestris* of Tatarstan, Russia, with gradually tapered pointed spicule (Skrjabin *et al.*, 1957; Petrov and Potekhina, 1953).

However, very caused the former species has a expansion of cephalic region in the male and much longer distance (>1 mm) between and anus posterior end of body in female, and the latter species has a ratio smaller (< 58%) as compared with the anterior body of the helminth in both sexes, the eggs are smaller (62-65 by 29 µm), separating from the present species (Petrov and Potekhina, 1953; Skrjabin *et al.*, 1957).

The genus *Trichuris* Roederer, 1761 species are commonly found, parasitizing vertebrate hosts including small mammals. These are reported from various countries including India but none from Pakistan. Present species is described for the first time from this locality and *Tateraindica* (Indian gerbil) is one type host and *Rattusrattus* being the other host.

Trichuris sp. is widely distributed among mammals regardless of their dietary habits and habitat preference. *Tateraindica* is a ground dweller, feeding mainly on earthworms (Musser and Durden, 2014) while *Mallomysrothschild i*is of arboreal nature principally, consuming a mainly abrasive vegetable diet (Flannery *et al.*, 1989). *Trichuris*hasun-embryonated eggs when passed in host feces and take several weeks to one month in a humid environment to become infective, but require no intermediate host (Anderson, 2000). The hosts acquire infection by eating diets or drinking water contaminated with embryonated eggs. This life history pattern may facilitate host-shifts. Actually, occurrence of such host-shift events in *Trichuris* evolution has been suggested by molecular phylo-genetic studies (Dolezalova *et al.*, 2015; Callejon *et al.*, 2015).

The spines in the spicular sheath in present specimens appear to be longer and slender then the spines on the spicular sheath in *T. bainae* which are bit broader at the base and comparatively smaller in height.

Present specimens differ in having a bigger body size of both male and females with having different lengths of whip like anterior and stouter posterior portions. The spicule lengths are smaller in size. Vulva in present specimens is simple and upward in direction, while in *T. bainae*the vulva is protrusive and ornamented with spines, the eggs are smaller in size in present specimens as compared to the eggs in *T. bainae* and different hosts.

T. musseri from *Echiothrixcentrosa* and *T. mallomyas* from *Mallomysrothschildi* differ mainly from the present specimens in having distal end sharply pointed of the spicule which was gradually tapering, while the former species is distinguished from the later by having much smaller body size and large number of nuclei per sub division of stichosome. As the present specimens do not match exactly with the congeners a new species *T. tateri* is proposed.

Although the present specimens being discussed appear to be similar with the reported species of the genus in general morphological features. Main differentiating characteristics are: the range of spicular lengths 0.96-1.76 (1.36) a marked difference in the sizes of the spicule in the specimens studied and an upward direction of the vulva opening in female. Present species also differ from previously described species: in general body dimensions size of the spicule, pattern of tubular testis, vas deferens, seminal vesicle, cloacal tube, presence of spicular tube etc. *T. chiliensis* is different from the present specimens in having spicule greater in length and in having vulva with a prominent downward direction and eggs larger in size, a different host and locality. *T. Bradley* differs from the present specimens in the absence of a true spicular sheath, in the spicule lying in the cloaca and in the division of the cloacal tube into proximal and distal regions. *T. fossor* differ in having bilo bed end in male, bell-shaped spiny-spicular sheath. Vulva situated on a prominence in *T. citelli*, eggs are 70-74 by 33-35 microns which are larger than the eggs in present specimens.

The compilation of Skrjabin *et al.*, 1971 reports *Trichurisparvispicular is* Clapham, 1945 and *T. controta* Rudolphi, 1819. Systematic status of *T. p. spicularis* raised doubt by Verster, 1960who had opinion of it being

the same of *T. vondwei.* Seven potential species were excluded from these compilations; *T. petteri* Quentin, 1966, *T. gerbillis* and *T. gundii* Bernard, 1969, *T. pedetei; T. procaviae* Verster, 1960; *T. mastomysi* and *T. hyraces* Ezzat, 1954.More so ever, the crested porcupine *Hystrixcristata* (Hystricidae) an African endemic rodent (Grubb *et al.,* 2008)has been described to be infest by *T. hystricis* Kreis, 1938 and *T. infundibulus* Linstow, 1906. Although the first description of *T. hystricis* might be thought to be doubtful as it was based on material in confined porcupines from Basel Zoo (Switzerland). Bernard (1987) recorded whipworms consistent with *T. hystricis* description, but from *Hystrixcristata* from Tunis Zoo. *T. infundibulus* locality is not mentioned in the earliest description and no facts provided on *Trichuris* from wild African crested porcupines. Brouat and Duplantier, 2007 reported undetermined species of the genus *Trichuris* from Senegal in *Mastomyserythroleucus* and *M. natalensis*.

According to the literature search genus *Trichuris* Roederer, 1761 species reported from rodent hosts are: *T. fossor* (Hall, 1916) Chandler, 1945 from *Thomomysbottae; T. citelli* Chandler, 1945 from *Citellusbeecheyi; T. perognathi* from *Perognathuscalifornicuscalifornicus; T. neotomae* from *Neotomafuscipes.* Yong, 1971 encountered *T. muris* (Schrank, 1788) Hall, 1916 from various Malaysian rodent hosts: *Rattusrattusdiardi; R. exulans; R. jaloresis; R. argentiventer; R. mulleri; R. sabanus; R. annandeli; R. canus; R. crimoriventer; R. rajah* and *R. gliroides.* Babero*et al.,* 1975 reported *T. bradlyi*from *Octodondegus*in Santiago, Chile. The same authors reported *T. chiliensis* from *Akodonlongipilis* in Chile. Mascoma and Feliu, 1977 reported *T. muris* from *Rattusrattus* and *Apodemussylvaticus.* Molan *et al.,* (1988) in a survey of intestinal helminthes reported *T. muris* some rodents in Arbil, Iraq.

Conclusion

Genus *Trichuris* Roederer, 1761 new species is being described from Indian gerbil and rat in Karachi, its suburbs and Sujawal, Sindh, Pakistan.

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