Helminth Parasites of Bats (Chiroptera: Rhinopomatidae Bonaparte, 1838) from the Persian Gulf Coastal Area

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ABSTRACT

Introduction: Bats are natural reservoir hosts of several zoonotic infections. Few studies have demonstrated gut helminth community parasite in bats. In the present study, we investigated two intestinal helminths of two bat species, Rhinopoma muscatellum, and Rhinopoma microphyllum, from Hormozgan province, southern Iran. Methods: We received digestive tracts of 56 Rhinopoma bats previously captured by several biologists. The specimens were precisely dissected and examined for the parasitic helminths. The collected helminths were cleared in the lactophenol and identified using reliable morphological and morphometrical key references. Result: In this study, 44 R. muscatellum and 6 R. microphyllum species were examined, among which 15 (26.7%) had infections with parasitic worms. Lecithodendrium sp. and Castoria sp. were identified in the digestive tract of eight and four individually examined R. muscatellum bats, respectively. Also, in three R. microphyllum bats, a few spirurid nematodes with incomplete structures were detected. Conclusion: We, for the first time, identified Lecithodendrium sp., Castoria sp., in R. muscatellum from south of Iran. Due to the insectivorous biological trait of bats, the most abundant helminth was Lecithodendrium sp. Further study with more samples is needed to describe the helminths fauna of microbats in Iran taxonomically.

INTRODUCTION

Mouse-tailed bats are a group of insectivorous microbats of the family Rhinopomatidae, with only three to six species in the single genus of Rhinopoma according to different reliable references [1-3]. They are prevalent in the Old World, from North Africa to Thailand and Sumatra, in arid and semiarid regions, roosting in caves, houses, and even the Egyptian pyramids. These microbats are moderately small, with a 5-6 Cm body and a weight ranging from 6-14 g [1, 2]. In Iran, the most prevalent Rhinopoma species is the small mouse-tailed bat (R. muscatellum). This bat has a free tail, which in most cases, is longer than the forearm length. This species has a hairless face with a small noseleaf on the snout and large ears connected across the forehead [3]. R. muscatellum has a limited distribution around the Persian Gulf and occurs in Oman, Yemen, the United Arab Emirates, Afghanistan, Western Pakistan, and India and Iran's coastal area [4, 5]. The other Rhinopoma species, R. microphyllum, a greater mouse-tailed bat, prevails in southwestern Iran. In this species, the skull length is 18-22 mm, and the forearm measures 57-72 mm. The Rhinopoma species live in colonies in caves, holes, and quiet houses and feed on insects and hunts using echolocation [2, 5].

There is substantial evidence that bats serve reservoirs for various zoonotic pathogens, including viruses, fungi, parasites, and bacteria. Hence, contact between bats, other animals, and humans can cause interspecies transmissions and disease outbreaks [6]. Bats harbor zoonotic viruses such as SARS COVID-19, SARS coronavirus, Nipah virus, Hendra virus, and Ebola virus [7, 8]. These small mammals carry protozoans of the genera Plasmodium and Trypanosoma and parasitic helminths, including trematodes, cestodes, and nematodes [9]. Moreover, ectoparasites like ticks, mites,
bugs (Hemiptera), fleas (Siphonaptera), and flies (Diptera) parasitize these small mammals [10].

Several studies have investigated the microbial community inhabiting bats regarding bats' impact as reservoirs of emerging infectious diseases [6-8]. However, few studies have focused on the parasite diversity within bats. For the first time in this study, we investigated the gastrointestinal tract of *R. muscatellum* and *R. microphyllum* from the south of Iran for parasitic helminths.

**MATERIALS AND METHODS**

In the present study, 56 digestive tracts of bat carcasses previously captured and identified by zoologists were transferred to the Helminthology Laboratory at Tehran University of Medical Sciences. The bats had been captured in the Hormozgan province of Iran, the Persian Gulf northern littoral areas (Fig1), and the specimens were preserved at -20 °C. The gastrointestinal tracts were cut open longitudinally, and the entire contents were transferred to normal saline and carefully examined for helminths under a stereomicroscope and in higher magnifications (100X and 400X) by a microscope. The collected worms were cleared in lactophenol to become transparent, stained with azocarmine and carmine acid, and then were mounted using Canada balsam. The identification of Helminths was achieved based on morphological and morphometrical characters using reliable key references [12, 13].

**RESULTS**

In this study, the intestinal content of 50 *R. muscatellum* and 6 *R. microphyllum* bats were examined for helminths. Out of 56 bats, 15 (26.78%) had infections with parasitic worms, and 41 (73.21%) showed no helminth infection. *Lecithodendrium* sp. and *Castoria* sp. were observed in the digestive tract of eight and four individually examined *R. muscatellum* bats, respectively (Figs 2, 3, and Table1). In three *R. microphyllum* bats, some damaged spirurid nematodes, most probably of the genus *Physaloptera*, were also detected. Overall, *Lecithodendrium* sp. was the most abundant helminths in the gastrointestinal tracts of *R. muscatellum* (Table1). No helminths mixed infection was observed in bats.

**Morphological characters.** The recovered trematode specimens from the *R. muscatellum* bats were measured carefully, as described below, and compared with specimens described in Russian references [13].

![Fig 1. Map of Iran and the sampling area (Hormozgan province, the Persian Gulf northern littoral areas); triangles illustrate the sampling localities.](image-url)
Fig 2. *Lecithodendrium* sp. isolated from *R. muscatellum* bats, drawn by camera lucida (10X).

Fig 3. *Castoria* sp. isolated from *R. muscatellum* bats, drawn by camera lucida (10X).
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**Table 1. Different species of helminth parasites in the Rhinophyma bat.**

<table>
<thead>
<tr>
<th>Helminth species</th>
<th>Bat species</th>
<th>R. muscatellum (No.)</th>
<th>R. microphyllum (No.)</th>
<th>Total No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecithodendrium sp.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Castoria sp.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spirurid nematodes, Physaloptera sp.</td>
<td>8</td>
<td></td>
<td>8 (14.28%)</td>
<td></td>
</tr>
<tr>
<td>infected</td>
<td></td>
<td></td>
<td>4 (7.14%)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>3 (5.35%)</td>
<td></td>
</tr>
<tr>
<td>uninfected</td>
<td></td>
<td></td>
<td>41 (73.21%)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>6 (10.71%)</td>
<td></td>
</tr>
</tbody>
</table>

**Discussion**

Bats are the natural reservoirs for various zoonotic diseases. Several studies have demonstrated the microbial infection in bats; however, the information on the helminth that parasites are scarce [1]. The present study investigated the helminths parasites of the bats belonging to the Rhinopoma genus from the south of Iran. Out of 50 R. muscatellum bats, 15 (26.7%) showed helminth infections in the gastrointestinal tract; eight had infections with the trematode Lecithodendrium sp., four with Castoria sp., the first R. muscatellum infection report with these helminths in Iran.

Studies that focus on bat endoparasites are rarely available in the literature. In Iran, the only work on 18 lesser mouse-eared bats, Myotis blythii (Chiroptera, Vespertilionidae) from Zanjani Province, revealed Hymenolepis rhinopomae, Molinostrongylus alatus in the digestive tract of these bats. M. blythii was defined as the new host for H. rhinopomae, and M. alatus in this bat species was reported for the first time in Iran [14].

In a similar survey on pipistrelle bats (Pipistrellus pipistrellus and P. pygmaeus) in the Greater Manchester and Lancashire region of England, of 90 adult and juvenile bats examined for gastrointestinal helminths by morphological and molecular analyses, 68 (76%) had infections with at least one species of digenean trematodes including Lecithodendrium linstowi, L. spatulatum, Prosthodendrium sp., Plagiorchis koreanus, and Pyncnoporus heteropus [15].

A study in Egypt on 1264 bats from eight different species, including Rousettus aegyptiacus, R. hardwickei, R. microphyllum, Taphozous nudiventris, Nycteris thebaica, Rhinolophus clivosus, Otonycteris hemprichii, and Asellia tridens, demonstrated that the strict host specificity was not a notable feature of trematode infections. However, a definite preference for some trematodes genera to certain bat species was observed [16].

In China, 56 bats from eight species belonging to the families Rhinolophidae, Hipposideridae, Vespertilionidae, and Molossidae were investigated for parasitic helminths. Infections with cestodes of Vampirolepis sp. were detected in Rhinolophidae bats, and Hymenolepis sp. was identified in Hipposideridae bats [17].

Rosskopf et al. (2019) detected Nycteria (order Haemosporida), an arthropod-borne blood parasite in Rhinolophus bats, and Polychromophilus in Miniopterus minor bats in Ngounié province, Gabon [18]. In Serbia, an examination of 118 bats revealed six digenean species, including Lecithodendrium linstowi, Plagiorchis sp., Prosthodendrium longiforme, P. chilostomum, P. parvouterus, and Mesotretes peregrinus [19].

Similar to previous reports, in our study, due to the host's diet, the most prevalent helminths in Rhinophoma bats was a digenean trematode, Lecithodendrium sp., followed by Castorai sp. Indeed, metacercaria of digenean trematodes often develops in the body of larvae and nymphs of aquatic insects of the order Plecoptera, Ephemeroptera, Odonata, or Trichoptera [20]. Given that Rhinopomatidae bats are insectivorous, having these trematode infections is highly probable.

Moreover, in the current study, the spirurid parasite, Physaloptera sp. were also detected in R. microphyllum, while the partially damaged worms did not allow us to reach a conclusive identification of the species. Since this helminth's zoonotic aspect is a concern from the public health perspective, further studies are required to investigate bats’ potential role in accidental human...
infection. The current paper illustrated Lecithodendrium spp., Castoria spp., in R. muscatellum in the south of Iran for the first time. We hope that this study triggers further works to improve our knowledge of bats’ possible role in the emergence of zoonotic agents.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest associated with this manuscript.

REFERENCES


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