



Contents lists available at ScienceDirect

## Asian Pacific Journal of Tropical Disease

journal homepage: [www.elsevier.com/locate/apjtd](http://www.elsevier.com/locate/apjtd)

Document heading

doi:10.1016/S2222-1808(14)60321-2

© 2014 by the Asian Pacific Journal of Tropical Disease. All rights reserved.

## A new flea from Iran

Mohammad Mehdi Darvishi<sup>1</sup>, Mohammad Reza Youssefi<sup>2</sup>, Emad Changizi<sup>3</sup>, Rasoul Rostami Lima<sup>4</sup>, Mohammad Taghi Rahimi<sup>5\*</sup>

<sup>1</sup>Department of Parasitology, Semnan, Iran

<sup>2</sup>Department of Parasitology, Islamic Azad University, Babol Branch, Babol, Iran

<sup>3</sup>Department of Parasitology Veterinary, Semnan, Iran

<sup>4</sup>Shahmirzad Veterinary Faculty, Semnan, Iran

<sup>5</sup>Young Researchers Club, Islamic Azad University, Babol-branch, Babol, Iran

## PEER REVIEW

## Peer reviewer

Behzad Esfandiari, Assistant Professor, Epidemiology department of Pasteur Institute, Tehran, Iran.

Tel: +989111836073

Fax: +985442451

E-mail: [esfandiari88@hotmail.com](mailto:esfandiari88@hotmail.com)

## Comments

Fleas are blood sucking ectoparasites of mammals and birds. Furthermore, the problems posed by the creature itself, they act as a vector for disease. Fleas transfer viral, bacterial, rickettsial protozoans and helminths diseases to humans and animals. The authors describe occurrence of a new Siphonaptera from house mouse (*M. muscuuls*) in Iran. The manuscript properly indicates major criteria for species identification and it reports a new flea in Iran.

Details on Page 87

## ABSTRACT

Fleas are obligatory ectoparasites of humans and animals. These tiny insects are hematophagous and they can transmit a wide variety of disease agents to humans and domesticated animals. Indeed, this pest causes a considerable economic damages and health dangers particularly in tropical and subtropical. During an investigation on ectoparasites of five *Mus muscuuls* in Semnan province, Iran, 15 fleas (8 males and 7 females) were collected. The extracted fleas mounted using clearing, dehydrating, mounting process and preserved with Canada balsam. After precise study, all of examined specimens were recognized as *Leptopsylla aethiopicus aethiopicus* using available systematic keys. This is the first report of this genus and species in Iran. And this country is new locality for *Leptopsylla aethiopicus aethiopicus*.

## KEYWORDS

Flea, Ectoparasite, Rodent, House mouse, *Mus muscuuls*, Iran

## 1. Introduction

Fleas are Arthropods, which belongs to order of Siphonaptera. These ecoparasites are considered as a highly specialized blood sucking on a wide variety of warm-blooded vertebrates including humans, live stock, dogs, cats, chickens, rabbits, squirrels, rats, mice, etc. Fleas are a matter of high importance not only in medical but also in

veterinary fields, particularly in tropical and subtropical which prepare all conditions for flea life cycle and increase of their populations. Humidity plays a critical role to flea survival. Eggs require relative humidity of at least 70%–75% to hatch and also larvae require at least 50% humidity to stay alive. In humid areas, about 20% of the eggs survive to adulthood. Even though in arid regions, less than 5% can complete their cycle. Fleas thrive at higher temperatures,

\*Corresponding author: Mohammad Taghi Rahimi, Young Researchers Club, Islamic Azad University, Babol-branch, Babol, Iran.

E-mail: [rahimimt@gmail.com](mailto:rahimimt@gmail.com)

Foundation Project: Supported by the Young Researchers Club, Islamic Azad University, Babol Branch., (Grant NO.: BPJ1390)

Article history:

Received 11 Oct 2013

Received in revised form 20 Oct, 2nd revised form 28 Oct, 3rd revised form 11 Nov 2013

Accepted 21 Feb 2014

Available online 28 Apr 2014

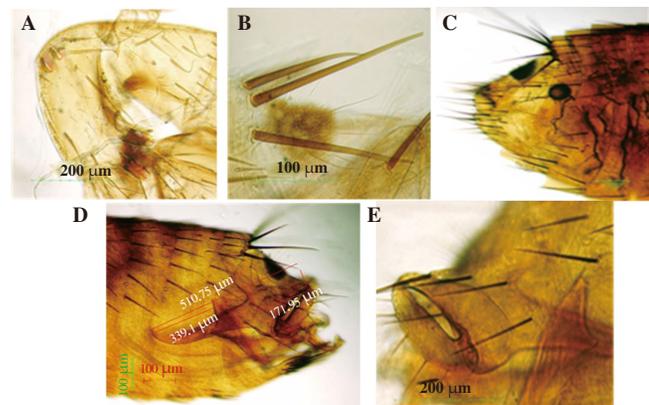
but need a temperature range of 21 °C to 32 °C to continue to exist. Lower temperatures slow down or completely interrupt the flea life-cycle[1]. These insects transmit a variety of viral, bacterial and rickettsial diseases to humans and other animals, as well as protozoans and helminthes including *Yersinia pestis*, *Rickettsia typhi*, *Rickettsia felis*, *Bartonella henselae*, *Hymenolepis nana*, *Hymenolepis diminuta*, *Diploidium caninum*, trypanosome and myxomatosis. Besides that these tiny pets can be considered as a vector of the above mentioned microorganisms, the creature can pose problem by itself. Fleas are hematophagous pests which are equipped with highly specialized mouthparts that can pierce their host skin to provide their vital requirements. Their bite leads to a severe allergic reaction that is called flea allergy dermatitis due to antigens of flea saliva. They are flattened from side to side and are wingless with size of 1.5 to 3.0 mm. Their legs are long which are well adapted for jumping. Both sexes female and male must feed on host by blood sucking to prepare for reproduction. Female fleas lay nearly 5000 eggs over their life. In general, though fleas are not very host specific, they have preferred hosts[2]. Considering all aforementioned facts, it is crystal clear that increase of our knowledge regarding flea distribution, host and transmission of causative agents of diseases is necessary for following efficient control and elimination programs. In the current report, a new species of flea is introduced from *Mus muscuuls* (*M. muscuuls*) (house rat) in Iran.

## 2. Case description

An investigation were carried out on ectoparasites of five *M. muscuuls* (2 males and 3 females) which were captured using live traps (April 2011) in Semnan province (35.5769°N 53.3953°E), Iran. After transferring the rodents to the laboratory, 15 fleas (8 males and 7 females) were collected from two *M. muscuuls*. All specimens mounted using clearing, dehydration and mounting procedure and finally preserved with Canada balsam for more investigation.

Examined specimens share the following characters: The mean of length in males and females were 2153 µm and 2234 µm, respectively. The investigated samples had two types of spines: genal ctenidium had three spines without any gap while the tip of middle spine was thicker in comparison with the base (bludgeon shape) and the length was longer than upper and lower spines (58 µm, 69 µm and 62 µm, respectively).

The base near the eye did not touch the dorsal margin of the upper spine and the width of the genal process above first genal spine was broad (Figure 1A). On each side of prenatal ctenidium, 13 spines were observed. All of them were quite identical in size, shape and color. Their base was darker and thicker where the tips of them were sharper and lighter. In part of fronts, two frontal spini forms and one seta above them were observed. Fore coxa is inserted below of prosternum. Moreover, mezosternum of examined fleas was divided into two parts by meral rod which is a thick vertical line.



**Figure 1.** A: Genal ctenidium, B: Antepygidal setae of male, C: Antepygidal setae of female, D: Clasper and manubrium of male, E: Setae of movable process in male.

Males had three antepygidal setae on left and right sides and the middle one was obviously longer than others while four antepygidal setae of females on the each side were separated by conspicuous interspace into two groups. The interior seta noticeably was shorter in each group (Figure 1B and 1C). The ratio of manubrium to clasper in specimens was nearly 2:1, (361.74 µm and 181.21 µm, respectively) (Figure 1D). The fixed section of clasper looked triangular and blunt. The movable part was not so bent and there was a noticeable distance between fixed and movable parts. Furthermore, a wide interspace was observed between the 3rd and 4th posterior setae of clasper mobile section (Figure 1E).

The posterior edge of 7th sternum in females had a slight sinuous with a row of six setae under spermatheca which seen relatively comma shape. The 8th sternum of males was pointed and dorsal margin appeared concave or it was divided into two branches. Apical lobe of 9th sternum was setiferous and remarkably was covered by hair. Considering all crucial features, the collected specimens were recognized as *Leptopsylla aethiopicus aethiopicus* (*L. a. aethiopicus*) based on Service and Smit keys[2,3].

## 3. Discussion

Rodents are classified in order of Rodentia. These mammals play a major role in disease transmission by their bite, feces, urine and particularly ectoparasites. Different disease can be transmitted by rodents such as leptospirosis, plague, leishmaniasis, murine typhus, etc. Rats and mice are considered potential health dangers and also they cause considerable economical loses owing to their close contact with human and domesticated animal communities[4].

In the present study on ectoparasites of five *M. muscuuls*, a new species of flea *L. a. aethiopicus* was collected from two *M. muscuuls*. First time, *L. a. aethiopicus* was discovered by Roths in 1908 and normally this species is found in south of Sahara. This species is classified in fleas with three setas in genal ctenidium[5]. Leptopsyllidae family can be clearly distinguishable from other families considering genal and prenatal ctenidium, and meral rod. Epidemiologically are not cosmopolitan except *Leptopsylla segnis* (*L. segnis*). The number of seta of genal ctenidium is variable (from 3 to

6) and it is conducive to dividing this family. In addition, the identification of fleas is based on males due to having complicated and specific reproductive system. Nevertheless, females can be used as a complementary factor<sup>[3]</sup>. The causative agent of plague (*Yersinia pestis*) and murine typhus (*Rickettsia typhi*) were reported from *L. aethiopicus* and *L. segnis*, respectively<sup>[1,5]</sup>. Besides, *Rickettsia mooseri* was detected from *L. segnis*<sup>[6]</sup>.

An investigation was carried out on *M. musculus* in Lorestan province, Iran. Two fleas *Nosopsyllus fasciatus* and *Nosopsyllus iranensis* were reported<sup>[7]</sup>. In survey on ectoparasites of *M. musculus* captured in Bandar Abbas, Iran, no flea was observed<sup>[8]</sup>. Smit reported *L. algeria costai* from *M. musculus* in Palestine<sup>[9]</sup>.

Farhang–Azad described for the first time two new species from long–tailed hamster in Iran, *Paradoxopsyllus faghohei* which is close to *Microphthalmus* and another is *Phaenopsylla newelli* which is close to *tiflovi*. In addition to, *Ph. Kopetdag* was reported for the first time from Iran<sup>[10–12]</sup>. Farhang–Azad also reported some new species from Iran for the first time such as *Coptopsylla* from Esfahan Province, *Ctenophthalmus* from Khorasan Province and *Nosopsyllus*<sup>[13]</sup>.

In conclusion, this is noteworthy to mention that this is the first report of *L. aethiopicus* from *M. musculus* and Iran is a new locality for this species. Further investigation is highly recommended in order to study in unexplored area of our country to prepare a comprehensive list of Siphonaptera fauna in Iran.

### Conflict of interest statement

We declare that we have no conflict of interest.

### Acknowledgements

The authors would like to appreciate very much for kind collaboration of Dr. Mehdi Assmar in recognition of fleas. The authors declare that they have no conflicts of interest.

### Comments

#### Background

Fleas are cosmopolitan external parasites infesting a wide variety of animals. Fleas are considered as a matter of public health. These ectoparasites impose a considerable burden on human and animal and also human life is treated by these insects by their critical role in transmission of causative agents of diseases. Therefore, investigation on rodent ectoparasites Siphonaptera and providing a list of their fauna is highly significant.

#### Research frontiers

This study describes a case of flea identification for first time in Iran. According to entomological characteristic of Siphonaptera, the flea was diagnosed accurately as *L. a. aethiopicus*.

#### Related reports

Smit (1995) reported *L. algeria costai* from *M. musculus* in Palestine. And *L. segnis* is known as a cosmopolitan flea.

### Innovations & breakthroughs

This report is the first report of *L. a. aethiopicus* in Iran and it has a significant value. And also there is not any published data on Leptopsyllidae family in this country.

### Applications

This report presents a new flea in Iran and it can be considered as a very important reference. Besides, it increases our epidemiological information about Siphonaptera fauna in Iran and their host.

### Peer review

Fleas are blood sucking ectoparasite of mammals and birds. Furthermore, the problems posed by the creature itself, they act as a vector for disease. Fleas transfer viral, bacterial, rickettsial protozoans and helminths diseases to humans and animals. The authors describe occurrence of a new Siphonaptera from house mouse (*M. musculus*) in Iran. The manuscript properly indicates major criteria for species identification and it reports a new flea in Iran.

### References

- [1] Roberts LS, Janovy J. *Foundations of parasitology*. 9th ed. New York: Mc Graw–Hill; 2012, p. 594–602.
- [2] Service M. *Medical entomology for students*. 5th ed. New York: Cambridge university press; 2012, p. 178–193.
- [3] Smit FGM. On two African polytypic species of *Leptopsylla* (Siphonaptera). *Tijdschrift Voor Entomologie* 1951; **93**: 25–40.
- [4] Hill WA, Brown JP. Zoonoses of rabbits and rodents. *Vet Clin North Am Exot Anim Pract* 2011; **14**(3): 519–531.
- [5] Christou C, Psaroulaki A, Antoniou M, Toumazos P. *Rickettsia typhi* and *Rickettsia felis* in *Xenopsylla cheopis* and *Leptopsylla segnis* parasitizing rats in Cyprus. *Am J Trop Med Hyg* 2010; **83**: 1301–1304.
- [6] De Sousa R, Edouard–Fournier P, Santos–Silva M, Amaro F, Bacellar F, Raoult D. Molecular detection of *Rickettsia felis*, *Rickettsia typhi* and two genotypes closely related to *Bartonella elizabethae*. *Am J Trop Med Hyg* 2006; **75**(4): 727–731.
- [7] Shayan A, Rafinejad J. Arthropod parasites of rodents in Khorram Abbad district, Lorestan Provincen of Iran. *Iran J Public Health* 2006; **35**(3): 70–76.
- [8] EB Kia, Moghddas–Sani H, Hassanpoor H, Vatandoost H, Zahabiun F, Akhavan AA, et al. Ectoparasites of rodents captured in Bandar Abbas, Southern Iran. *Iran J Arthropod Borne Dis* 2009; **3**(2): 44–49.
- [9] Smit FGM. A new flea from palestine. *Proc Royal Entomol Soc London Series B, Taxonomy* 1950; **19**(3–4): 201–204.
- [10] Farhang–Azad A. The flea fauna of Iran IX. Distribution and hosts. *Bull Soc Pathol Exot Filiales* 1970; **63**: 107–126.
- [11] Farhang–Azad A, Neronov V. The flea fauna of the great gerbil (*Rhombomys opimus* Licht.) in Iran. *Folia Parasitol (Praha)* 1973; **20**: 343–351.
- [12] Klein JM, Mofidi CH, Chamas M, Karimi Y, Bahmanyar M, Seydian B. Survey on flea (Insecta, Siphonaptera) in Iran. *Bull Soc Pathol Exot* 1963; **56**: 533–550.
- [13] Abivardi C. *Iranian entomology–An introduction: Volume 1: Faunal Studies. Volume 2: Applied Entomology (Schriftenreihe Der Stiftung Franz Xaver Schnyder Von Wartensee, Bd. 59) (Vol 1)*. Germany: Springer; 2001, p. 843.