







Identification of Mites in Wild Rats in Simpang Limun Traditional Wet Market Area, Medan - Indonesia

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ARTICLE INFO

Article history:

Received December 20, 2023

Revised March 25, 2024

Accepted May 13, 2024

Available online May 13, 2024

E-ISSN: [2686-0856](https://doi.org/10.32734/jetromi.v6i2.14918)

P-ISSN: [2686-0872](https://doi.org/10.32734/jetromi.v6i2.14918)

How to cite:

Sianturi LA, Hutagalung SV, Darmadi, Lubis SM. Identification of Mites in Wild Rats in Simpang Limun Traditional Wet Market Area, Medan - Indonesia. Journal of Endocrinology, Tropical Medicine, and Infectious Disease (JETROMI). 2024 May 13;6(2):54–61. DOI: 10.32734/jetromi.v6i2.14918.

ABSTRACT

Background: Among human diseases are infectious diseases transmitted by animals to humans, called zoonoses. Rats carry ectoparasites that act as biological vectors in the transmission of zoonoses. Mites are ectoparasites of rats that cause various zoonoses, namely murine typhus, rat mite dermatitis, and others. The study aims to identify species of wild rats in the study area based on their morphology and presentation of mite-infected rats and mite species in wild rats in Simpang Limun traditional wet market in Medan, Indonesia.

Methods: This cross-sectional study used a purposive sampling technique. Primary data were collected in the Simpang Limun traditional wet market area of Medan, namely in the first area; M. Nawi Harahap Street, and the second area; Kemiri I Street. Every afternoon for four consecutive days, ten baited rat traps were deployed in each area. The captured rats were anesthetized, identified, and examined for mites by combing and then identified under a microscope.

Results: From 65 total wild rat samples, the majority of species found was *Rattus tanezumi* 60 (92.3%), followed by *Rattus norvegicus* 5 (7.7%). The identified mite species were *Laelaps echidninus* (84.5%) and *Laelaps nuttalli* (15.5%).

Conclusion: Nearly all of the wild rats found were of *Rattus tanezumab* species, and the most common mite species identified was *Laelaps echinus* in Medan's Simpang Limun traditional wet market area. This has a significant medical impact, resulting in increased potential for zoonosis transmission and indirectly to the surrounding residents in Medan's Simpang Limun traditional wet market area.

Keywords: Wild rats, Mites, Zoonoses

ABSTRAK

Latar Belakang: Pada manusia, penyakit menular yang ditularkan oleh hewan ke manusia disebut zoonosis. Tikus membawa ektoparasit yang bertindak sebagai vektor biologis dalam transmisi zoonosis. Tungau adalah ektoparasit tikus yang menyebabkan berbagai zoonosis, yaitu tifus murine, dermatitis tungau tikus, dan lain-lain. Penelitian ini bertujuan untuk mengidentifikasi spesies tikus liar berdasarkan morfologi dan presentasi tikus yang terinfeksi tungau, dan spesies tungau pada tikus liar di pasar basah tradisional Simpang Limun di Medan, Indonesia.

Metode: Penelitian cross-sectional ini menggunakan teknik purposive sampling. Data primer dikumpulkan di kawasan pasar basah tradisional Simpang Limun Medan, yaitu di Kawasan pertama Jalan M. Nawi Harahap, dan kawasa kedua Jalan Kemiri I. Setiap sore selama empat hari berturut-turut, sepuluh perangkap tikus berumpan dikerahkan di setiap daerah. Tikus yang ditangkap dibius, diidentifikasi, dan diperiksa tungau dengan menyisir dan kemudian diidentifikasi di bawah mikroskop.

Hasil: Dari 65 total sampel tikus liar, mayoritas spesies yang ditemukan adalah *Rattus tanezumi* 60 (92,3%), diikuti oleh *Rattus norvegicus* 5 (7,7%). Spesies tungau yang diidentifikasi adalah *Laelaps echidninus* (84,5%) dan *Laelaps nuttalli*



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<https://doi.org/10.32734/jetromi.v6i2.14918>

(15,5%).

Kesimpulan: Hampir semua tikus liar yang ditemukan adalah spesies *Rattus tanezumab*, dan spesies tungau yang paling umum diidentifikasi adalah *Laelaps echinus* di kawasan pasar basah tradisional Simpang Limun Medan. Hal ini memiliki dampak medis yang signifikan, sehingga meningkatkan potensi penularan zoonosis dan secara tidak langsung kepada warga sekitar di kawasan pasar tradisional Simpang Limun Medan.

Kata kunci: Tikus liar, Tungau, Zoonosis

1. Introduction

There are various sources of human disease, one of which is that animals transmit infectious diseases called zoonoses to humans [1]. It is estimated that 60% of known contagious diseases and up to 75% of newly emerging infectious diseases are zoonotic [2]. The Ministry of Health has recorded 150 zoonotic diseases that threaten Indonesia today. The zoonotic pathogens are viruses, bacteria, parasites, and fungi [3]. Zoonotic pathogens are transmitted to humans when animals carrying them, such as wild rats, are around humans [4]. The disease from wild rats spreads directly from contact with rat feces, urine, or water, even rat bites can cause infection [3]. Rats also carry several ectoparasites on their bodies. Ectoparasites act as vectors for the spread of pathogens between rodents and humans [5].

Among the ectoparasite groups found in wild rodents are mites that belong to the Acari subclass. The types of mites found in wild rats include *Ornithonyssus bacoti*, *Laelaps echidninus*, *Liponyssoides sanguineus*, and others. These zoonotic vectors are parts of health concern. Persistent dermatitis is the human body's response to mites that invade the skin with symptoms of irritation and allergies. They can also cause other diseases, such as rickettsialpox and scrub typhus, can be intermediate hosts for parasites such as tapeworms, and invade the respiratory tract and ear canal [6].

Based on the description above, the state of Medan's Simpang Limun traditional wet market, which has low hygiene, garbage scattered in various places, including leftover food waste, clogged gutters, and stagnant water, creating an atmosphere of a dirty and humid area, is an ideal location for a breeding habitat for wild rats. Therefore, conducting related research on the potential level and identification of mites present in wild rats in the area is essential. The collection of information and the results of this study are expected to be new data for those who need it in describing the potential of pathogens that can cause zoonoses from mites, prevention, and countermeasures against zoonoses caused by them.

2. Method

This is a descriptive study with a cross-sectional design. The sampling technique in this study was purposive sampling. This research was conducted based on applicable research ethical rules, namely ethical clearance NO: 749/KEPK/USU/2023. The research data was primarily taken in Simpang Limun's traditional wet market area. The independent variable in this study is wild rats. At the same time, the dependent variable is mites. Data processing was done with a univariate analysis test using SPSS.

2.1. Location and Time of Research

Sampling was conducted in the Simpang Limun traditional wet market area in Sudi Rejo II and Siti Rejo II Administrative Villages, Medan District, Medan City, precisely on Kemiri I Street and M. Nawi Harahap Street. This research was conducted in July - October 2023.

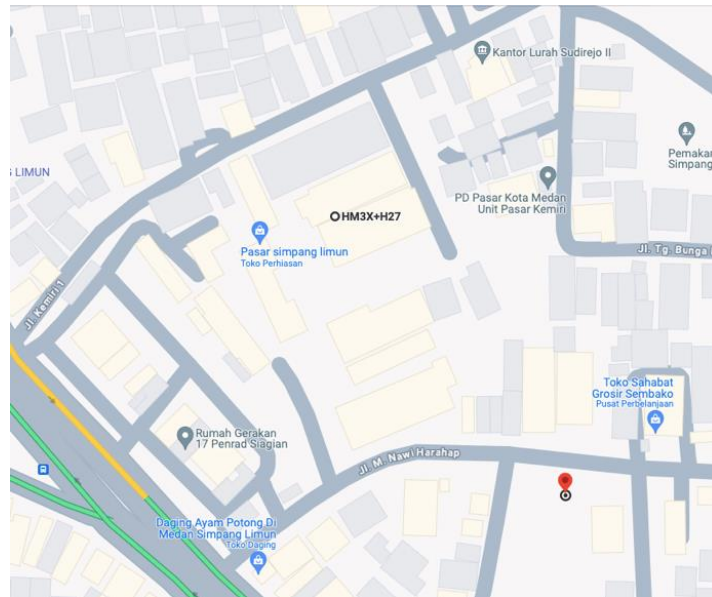


Figure 1. Map of the research location, namely Kemiri I Street (3°33'14.1"N 98°41'48.4"E) and M. Nawi Harahap Street (3°33'10.6"N 98°41'51.2"E).

2.2. Tools and Materials

The tools used in this study were mouse traps, microtubes, paper labels, stationery, Petri dishes, brushes, tweezers, binocular microscopes, flea combs, pipettes, gloves, masks, cloth bags, object glass, 3 ml syringe, and paper. This study used ketamine, xylazine, alcohol 80%, KOH 10%, distilled water, concentrated acetic acid, xylol, rats, salted fish, and entellan.

2.3. Working Procedure

2.3.1. Trap Installation

Rats were caught using bait rat traps spread along Kemiri I Street and M. Nawi Harahap Street of Simpang Limun traditional wet market area. The traps were placed in the afternoon for four consecutive days, at each location point of 10 traps on Kemiri I Street and 10 on M. Nawi Harahap Street. Each trap was labeled according to the location point. The trap's position is placed in the corner around the kiosk, and the distance of each trap is around 5-6 meters (10 footsteps), and the characteristics of the place are adjusted. The bait on the traps used salted fish to attract rats into the traps. Traps containing rats were collected in the morning. The bait in the traps was replaced every two days [7].

2.3.2. Sample collection and anesthesia

After the traps were collected, the rats were injected with a ketamine and xylazine mixture (ketamine dose was 70-100 mg/kg body weight, and xylazine dose was 2 mg/kg body weight). Afterwards, rats were left for \pm 5-10 minutes [7].

2.3.3. Mites Collection

After being anesthetized, on a tray covered with white paper, the rat's body was combed. The falling mites were taken using a brush dipped in 80% alcohol. Mites attached to the ears, the base of the tail, and the nose were picked up directly using tweezers. Next, the mites were put into 80% alcohol pot bottles and labeled [8].

2.3.4. Preparation of Mite Preparations

Mites were put into a pot bottle and a petri dish containing 10% KOH. According to the method of mite preparations, mites were observed after 2-3 days of immersion in 10% KOH. After that, the mites were washed three to four times with distilled water. The abdomen of the mite was punctured with a bent insect needle (30 mm), and followed by dehydration with 90% alcohol every ten minutes. After that, the mites were soaked in concentrated acetic acid for 15 to 30 minutes and washed with xylol. Then, the mites were placed on a glass slide, mixed with the entellan on top, and covered with glass [8].

2.3.5. Mites Observation and Identification

Mites were observed using a binocular microscope with 4x10 and 10x10 magnification. Identification of mite species was done based on their morphology [9,10].

3. Result

3.1. Frequency of Wild Rats in Simpang Limun Traditional Wet Market

From the study, more samples were found in M. Nawi Harahap Street 33 (50.8%) rats, while in Kemiri I Street 32 (49.2%) rats, (Table 1).

Table 1. Frequency of Wild Rats in Simpang Limun Traditional Wet Market

Location	N	Percentage (%)
M. Nawi Harahap street	33	50.8
Kemiri I street	32	49.2
Total	65	100

3.2. Frequency of Wild Rats Species in Simpang Limun Traditional Wet Market

Based on morphological identification, from a total of 65 rat samples, 60 of them were identified as *Rattus tanezumi* (92.3%), while five were *Rattus norvegicus* (7.7%) (Table 2).

Table 2. Frequency of Wild Rats Species

Species of Rat	N	Percentage (%)
<i>Rattus tanezumi</i>	60	92.3
<i>Rattus norvegicus</i>	5	7.7
Total	65	100

3.3. Percentage of Trap Success of Wild Rats in Simpang Limun Traditional Wet Market

The results of trap success were divided into two, there are < 7% (low) and > 7% (high) [11]. The trapping success in this study. with a total of 65 samples captured using 20 traps, was 81,25 % and is considered as high.

$$\text{Trap success} = \frac{\text{number of rats caught}}{\text{Number of capture periods} \times \text{number of traps}} \times 100\% = \frac{65}{4 \times 20} = 81.25\% \quad (1)$$

3.4. Frequency of Wild Rats Infected with Mites in Simpang Limun Traditional Wet Market

The findings showed that the number of infected wild rats was 53 (81.54%), while 12 rat samples (18.46%) were not infected with mites (Table 3).



Table 3. Frequency of Wild Rats Infected with Mites

Sample of Wild Rats	N	Percentage (%)
Positive	53	81.5
Negative	12	18.5
Total	65	100

3.5. Identification and Frequency of Mites in Wild Rats in Simpang Limun Traditional Wet Market

From the mite identification results, the number of *Laelaps echidninus* mites reached 93 samples (84.5%). Meanwhile, the identified *Laelaps nuttalli* was 17 samples (15.5%) (Table 4, Figures 1 and 2).

Table 4. Identification and Frequency of Mites in Wild Rats

No	Species of Mites	Picture	N	Percentage (%)	Description
1	<i>Laelaps echidninus</i>		93	84.5	The genitoventral plate is greatly enlarged, concave posteriorly, and surrounds the anterior part of the anal plate
Figure 2. <i>Laelaps echidninus</i> 10x10 magnification					
2	<i>Laelaps nuttalli</i>		17	15.5	The genitoventral plate is convex, not enlarged, and does not surround the anal plate
Figure 3. <i>Laelaps nuttalli</i> 10x10 magnification					

4. Discussion

4.1. Percentage of Trap Success of Wild Rats in Simpang Limun Traditional Wet Market

The trapping success in Simpang Limun's traditional wet market was 81,25%. The trapping success for rats in the area is >7%, which means the density of rats in the location is high. This is in line with a previous study which showed that trap success in Banjarnegara City Market is in the high category [12]. The presence of rats in the human environment can reflect the sanitation of the environment. As a wet market, due to the common sight of untidy non-permanent kiosks and market stalls, and the frequent view of scattered garbage and muddy ground conditions, it is suggested that the Simpang Limun traditional wet market requires improved sanitation and organization, The non-permanent stalls have many food sources and leftovers which create a favorable place for rats to live and breed. This is following the finding from a former study which found that the high trap success was due to poor sanitation and the large amount of food waste in the market area of Banjarnegara City [12]. In addition, another study described the success rate of trap success can also be influenced by several factors, such as the quality of the trap, the accuracy of bait selection, the density of rats, and the proper placement of mouse traps in the rat runway [13]. As rats have thigmotaxis properties, namely having the same trajectory when looking for food, nests, and other daily activities, hence proper placement of mouse traps is required.

High rat density has a significant medical impact. It may lead to increased direct and indirect transmission of zoonoses. Some examples of indirect transmission can be caused by ectoparasites, such as mites that cause rat mite dermatitis, Hemorrhagic Fever With Renal Syndrome (HFRS), and tularemia, ticks that cause bubonic plague, and ticks that cause Lyme disease, and various diseases caused by parasites, bacteria, and viruses [14,15]. In addition to the easier transmission of zoonoses, an increase in rat densities can produce negative effects which include economic losses, property damage, and psychological impacts that create discomfort and fear in the community. This can harm the market image and affect the attractiveness of the market for buyers [16].

4.2. Morphological Identification and Percentage of Wild Rats in Simpang Limun Traditional Wet Market

The original habitat of *Rattus tanezumi*, also known as the Asian house rat, is the roof of people's houses [17]. Based on observations, *Rattus tanezumi* is often found in non-permanent market stalls and kiosks located around and near human residences due to food diversity. In non-permanent stalls around the kiosks, nest holes, bite marks, and feces from *Rattus tanezumi* were easily found [18,19]. Meanwhile, *Rattus norvegicus* was commonly found in sewers [20]. *Rattus norvegicus* is relatively few in the Simpang Limun market area because it has few waterways that tend to be clogged, so the water became stagnant and closed. In addition, no nest holes of *Rattus norvegicus* were found in the area. Other studies also described similar findings, citing that the habitat of this rat was sewers in urban and rural areas [18, 21].

Some potential public health impacts, especially due to the high presence of *Rattus tanezumi*, are the direct spread of zoonoses such as Hantavirus transmission [22], which increased by 13% in humans in Indonesia. It is also an intermediate host for the transmission of parasitic worms such as *Trychostrongylidae* and *Hymenolaepris diminuta*. *Rattus tanezumi* and *Rattus norvegicus* also carry ectoparasites such as mites (*Laelaps echidninus*, *Laelaps nuttalli*, *Ornythonyssus bacoti*, etc.) causing zoonotic diseases such as rat mite dermatitis which causes itching and rashes, Hemorrhagic Fever With Renal Syndrome (HFRS) which has clinical symptoms of fever, chills intense headache, nausea vomiting, and tularemia with clinical symptoms of fever, chills, swollen lymph nodes, ulceration in the skin or mouth, muscle pain, cough, and can be an intermediate host for parasites [14,15,23]. Apart from the expansion of zoonotic diseases caused by *Rattus tanezumi* and *Rattus norvegicus*, there are reduced hygiene, potential economic losses, property damage, and contamination of food in stalls and kiosks, as well as discomfort and fear among visitors and traders. Controlling the rat population in residential areas and markets requires periodic and continuous extermination [16].

4.3. Identification of Mites in Wild Rats in Simpang Limun Traditional Wet Market

Based on Azad (1986), Centers for Disease Control (1975), and other former studies [24,25], *Laelaps echidninus* has a brown body and is covered by long setae, a large ventral genital plate (epigynous shield) which widens posteriorly and seems to surround the anterior part of the concave anal plate. The anal shield has one pair of perianal setae and one anal setae.

Meanwhile, *Laelaps nuttalli* has the characteristics of a brown body covered by long hairs, the epigyne shield is not so wide posteriorly, convex, and not adjacent to the anal shield [25-27]. *Laelaps nuttalli* can be a vector of rickettsia [28].

The dominant presence of *Laelaps echidninus* can have potential impacts on public health. This mite is a vector of murine typhus disease, which has clinical symptoms of fever and chills, muscle aches, loss of appetite, nausea and vomiting, abdominal pain, cough, and rash. People affected by rat mite dermatitis will experience lesions that are itchy, swollen, red, and papule-like in certain parts of the skin. In tularemia, the clinical symptoms are fever, chills, swollen lymph nodes, ulceration in the skin or mouth, muscle pain, cough, fatigue, and joint pain. Hemorrhagic Fever With Renal Syndrome (HFRS) has general symptoms such as intense headache, nausea and vomiting, back and abdominal pain, fever, chills, and blurred vision. Some individuals experience eye redness and rash. There are zoonotic diseases caused by *Laelaps nuttalli*, such as rat mite dermatitis and Hemorrhagic Fever With Renal Syndrome (HFRS). Some of the complications of zoonotic diseases are very dangerous, hence the need for prevention, proper diagnostics, and prompt treatment is essential [15,23,14]. Although the cases were not yet reported in this area, the presence of the wild rats and their ectoparasites proved the potential transmission of these infections.

4.4. Percentage of Wild Rats Infected with Mites in Simpang Limun Traditional Wet Market

Based on the data obtained, most rats were positive for mite infection. This is following a former study which described that the percentage of rats infected with mites was higher than those not infected in Jatingaleh Market and Kedung Mundu Market [29]. In this study, we also found that in the captured species *Rattus tanezumi* and *Rattus norvegicus*, the mite *Laelaps echidninus* was more dominant. This finding aligns with another study in Pasar Raya, Padang [30] and a former study by Adiyati [31].

The high tendency of wild rats to be infected with mites indicates that the transmission rate of various zoonotic diseases will be easier to occur. This is especially true in places where direct contact between rats and humans is high, such as markets. By understanding the interaction between rats and mites, people can be aware and contribute more to prevent and control diseases related to rats and mites. In addition, it is also necessary to control the rat population, and measures to reduce the risk of transmission through ectoparasite mites are essential in maintaining public health [16].

5. Conclusion

This study found that in the Simpang Limun traditional wet market area, among the captured wild rats, more *Rattus tanezumi* were identified than *Rattus norvegicus*. Most of the wild rats were infested with ectoparasite mites (81.5%). The majority of mite species identified were *Laelaps echidninus* and *Laelaps nuttalli*, with *Laelaps echidninus* being found as more abundant. These findings marked the eminent potential for zoonosis transmission in the area.

6. Acknowledgments

The study was partially supported by Penelitian Dosen Perintis Faculty of Medicine Universitas Sumatera Utara 2023 grant (contract number: 09/UN5.2.1.1/SK/PPM/2023).

7. Declaration of competing interest

The authors declare that no known conflicts of interest are associated with this study.

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