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The Potential of House Geckos in the Spread of Salmonellosis in Makassar City

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Abstract

Salmonellosis is a significant global public health concern caused by the bacterium *Salmonella* spp. As a zoonotic disease, it can be transmitted between animals and humans, leading to various clinical symptoms in humans, including gastroenteritis, diarrhea, vomiting, enteric fever, and septicemia. This study examines the presence of *Salmonella* spp. in house geckos (*Hemidactylus frenatus* and *Cosymbotus platyurus*), which may act as zoonotic reservoirs. A total of 50 house geckos were collected from residential areas across five districts in Makassar City—Biringkanaya, Tamalanrea, Tallo, Manggala, and Rappocini—from March to September 2024. Skin, oral, and fecal samples from the geckos were cultured on nutrient agar, brain heart infusion broth, and selective Salmonella-Shigella agar, with bacterial identification confirmed using MALDI-TOF mass spectrometry. Findings revealed the presence of *Salmonella enterica* ssp. *enterica* in geckos from the Manggala district, highlighting a potential pathway for environmental contamination and zoonotic disease transmission. This study underscores the need for public awareness regarding the health risks associated with household reptiles and emphasizes preventive sanitation measures to reduce potential pathogen exposure. These findings serve as a foundation for future research on zoonotic reservoirs in urban environments.

Keywords: house geckos, zoonotic reservoirs, Salmonella transmission, salmonellosis, urban health risks.

Introduction

House geckos, particularly *Cosymbotus platyurus*, *Hemidactylus frenatus*, and *Gehyra mutilata*, are prevalent in urban settings across Southeast Asia, including Indonesia, where they thrive in urban environments such as homes, offices, and schools (Ariffin et al., 2016). Their behavior typically involves crawling along walls and ceilings in search of insects, especially those attracted to light sources. Geckos often congregate around light fixtures and are frequently observed in

dining rooms and food storage areas, where they may inadvertently contaminate human food sources (Lo, 2013).

In recent years, house geckos have been increasingly recognized as potential carriers of zoonotic pathogens, including non-typhoidal *Salmonella* spp. (Callaway et al., 2011; Arnafia et al., 2016). Geckos, in general, are asymptomatic carriers of various enteropathogenic bacteria, such as *Citrobacter freundii*, *Enterobacter cloacae*, *Klebsiella pneumoniae*, and *Escherichia coli*, which can be transmitted to humans through contact with contaminated surfaces or ingestion of tainted food (Al-Taii et al., 2017). Geckos may deposit feces indiscriminately, potentially contaminating household environments and contributing to the spread of pathogens. This behavior, coupled with their pervasiveness in residential areas, underscores the zoonotic risk they pose (Nguyen et al., 2018).

Salmonellosis, caused by *Salmonella* spp., remains a critical global health issue, responsible for approximately 1.3 billion cases annually and over 3 million fatalities worldwide (Drosdz et al., 2021). The disease primarily manifests as gastroenteritis, diarrhea, vomiting, enteric fever, and, in severe cases, septicemia (Bjelland et al., 2020). This study investigates the prevalence of Salmonella spp. in house geckos collected from five districts in Makassar City: Biringkanaya, Tamalanrea, Tallo, Manggala, and Rappocini. By focusing on geckos as potential carriers of zoonotic pathogens, this research highlights the importance of sanitation practices and public awareness in mitigating health risks associated with household reptiles.

Meterials and Methods

This study employed a descriptive research design to detect and identify *Salmonella* spp. in house geckos within Makassar City. Sampling was conducted across five districts: Biringkanaya, Tamalanrea, Tallo, Manggala, and Rappocini. The geckos were collected from residential areas during nighttime, when these species are most active, ensuring a sample size of 50 individuals (10 from each district).

Sampel Collection

Geckos were captured using a non-invasive technique to minimize harm, involving a broom to gently dislodge them from walls, after which they were handled with gloved hands and placed in perforated plastic containers for transport to the Laboratory of the Veterinary Medicine Study Program at Hasanuddin University. This method maintained the integrity of the samples while minimizing contamination risks.

Laboratory Equipment and Reagents

The laboratory examination used a range of equipment, including an autoclave, Erlenmeyer flasks, beakers, graduated cylinders, test tubes, a test tube rack, a scoopula, stirring rods, a spirit lamp, a graduated pipette, a microscope, an inoculating loop, an analytical balance, dropper pipettes, and glass slides. The materials employed for bacterial culturing and identification comprised Nutrient Agar (NA), Brain Heart Infusion Broth (BHIB), and selective Salmonella-Shigella Agar (SSA). Additional reagents included pH indicators, sterile distilled water, cotton, 0.96% saline solution, labeling paper, gentian violet, 3% Lugol's solution, 96% ethanol, basic fuchsin, and immersion oil.

Sample Processing and Culturing Procedures

Skin and oral cavity samples were collected aseptically from each gecko using sterile swabs, while fecal samples were extracted using sterile distilled water to ensure thorough sample acquisition. All samples were subsequently streaked onto sterile Nutrient Agar (NA) plates to promote initial bacterial growth and incubated at 37°C for 24 hours. Positive bacterial growth

was indicated by the presence of visible colonies on the NA plates. Bacteria that grew on the NA medium were then pooled by district, with samples grouped according to their respective sampling locations. This pooled culture was transferred into Brain Heart Infusion (BHI) solution for bacterial enrichment, with the goal of promoting further growth of Salmonella spp. The BHI cultures were incubated at 37°C for an additional 24 hours to achieve optimal bacterial proliferation for subsequent analyses.

Selective Culturing and Identification

The enriched samples were then streaked onto Salmonella-Shigella Agar (SSA) plates, incubated at 37°C for 24 hours to isolate *Salmonella* colonies selectively. Colonies presenting with characteristic *Salmonella* morphology on SSA were further processed. Biochemical identification was performed using Gram staining and biochemical tests, providing initial confirmation of bacterial identity. For species-level identification, bacterial isolates were sent to the Makassar Health Laboratory Center, where they were analyzed using Matrix-Assisted Laser Desorption Ionization-Time of Flight (MALDI-TOF) mass spectrometry. This technique enabled precise identification of *Salmonella*.

Results and Discussion

The results showed a change in histology in the group given gentamicin. The increase in the Johnsen score in all groups receiving tamarillo katarrung extract is presented in Table 2. Table 2 shows a change in the histology of the Wistar rat testes in the control and treatment groups. The P2 group treated with tamarillo katarrung 200mg/kg and gentamicin induction had the highest score with a Johnsen score of 7.6 1.14 than the K-, K+, and P2 groups. The lowest value was shown by the K+ group in the treatment only induced by gentamicin, with a Johnsen score of 5.6 1.8. This indicates that the stages of administering gentamicin (K+) were impaired compared to the K-, P1, and P2 groups.

The study identified two species of house geckos: *Hemidactylus frenatus* (36 individuals) and *Cosymbotus platyurus* (14 individuals). The absence of *Gehyra mutilata* in the sample is likely due to its preference for indoor habitats, such as kitchens and dining areas, in contrast to the outdoor environments where collections were conducted. The distribution of gecko species is influenced by various ecological factors, including time, environmental heterogeneity, competition, predation, stability, and productivity (Muna et al., 2019). This variation aligns with the study's findings, which primarily captured species that occupy outer walls and ceilings.

The cultures obtained from swabs of external surfaces (skin), oral cavities, and fecal samples from the geckos are presented in Table 1. This table summarizes bacterial growth on Nutrient Agar (NA) across samples from five districts in Makassar.

Table 1. Growth of Colonies on Nutrient Agar

Gecko samples	Tamalanrea			Biringkanaya			Tallo			Manggala			Rappocini		
	S	O	F	S	O	F	S	O	F	S	O	F	S	O	F
Gecko 1	+	+	–	+	+	+	+	–	–	+	+	+	–	–	+
Gecko 2	+	+	–	+	+	+	+	+	–	+	+	+	+	–	+

Gecko 3	+	+	+	+	+	+	+	–	+	+	+	+	+	+	+
Gecko 4	+	–	–	+	+	+	+	–	–	+	+	+	+	+	+
Gecko 5	+	–	+	+	+	+	+	+	+	+	+	+	+	+	+
Gecko 6	–	+	+	+	+	+	–	–	+	+	+	+	+	+	+
Gecko 7	+	+	–	+	+	+	+	+	+	+	–	–	+	+	+
Gecko 8	+	+	–	+	+	+	–	+	–	+	+	+	+	+	+
Gecko 9	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Gecko 10	+	+	+	+	+	+	–	–	+	+	+	+	+	+	+

Table 1. Growth of colonies on Nutrient Agar. Key: "+" indicates bacterial growth, while "–" indicates no growth. S = skin samples, O = oral cavity samples, F = fecal samples.

Bacterial growth was observed in all samples from the Biringkanaya District on NA medium, while samples from other districts showed variable results. Some samples exhibited growth, while others did not, regardless of whether the samples were taken from skin swabs, oral cavity swabs, or fecal extractions. This variability may result from factors such as bacterial death or low bacterial presence in certain samples, potentially due to environmental factors or limitations in culturing techniques. Additionally, possible errors in the culturing process may have affected the results. Figure 1 below shows the NA medium with and without bacterial growth.

Figure 1. Left: NA medium with bacterial colonies; Right: NA medium without bacterial growth.

Following growth on NA medium, samples were pooled by district and further enriched in Brain Heart Infusion (BHI) solution. This enriched culture was then streaked onto selective Salmonella-Shigella Agar (SSA). Only fecal samples from the Manggala District showed growth on SSA medium, suggesting the presence of Salmonella spp., as shown in Table 2 and Figure 2.

Table 2. Growth of bacterial colonies on Salmonella-Shigella Agar (SSA) medium.

District	Skin swab	Oral cavity swab	Fecal matter
Tamalanrea	–	–	–
Biringkanaya	–	–	–
Tallo	–	–	–
Manggala	–	–	+
Rappocini	–	–	–

Key: "+" indicates bacterial growth, while "–" indicates no growth

Figure 2. Left: Bacterial colonies on SSA medium; Right: No bacterial growth on SSA medium.

To confirm bacterial identity, colonies from SSA were analyzed using Gram staining, oxidation tests, and MALDI-TOF mass spectrometry. The results confirmed the presence of *Salmonella enterica* ssp. *enterica*. This pathogen is known to cause salmonellosis, with potential clinical symptoms such as gastroenteritis and septicemia in humans. The presence of Salmonella in gecko fecal samples highlights a potential zoonotic risk within urban households, particularly in environments where geckos frequent food preparation and storage areas (Bjelland et al., 2020).

House geckos play an important role in household ecology, particularly in controlling insect populations that can become nuisances to humans and other household animals. However, while they contribute to insect control, they also acquire bacteria both vertically—from parent to offspring—and horizontally through environmental exposure. This study observed that all captured geckos carried bacteria asymptomatically on their skin, in their oral cavities, or in their feces. This asymptomatic carriage aligns with findings in other studies, which report that reptiles, including geckos, often harbor zoonotic bacteria without visible clinical signs (Al-Taii et al., 2017). Geckos primarily consume a variety of small insects, including isopods,

centipedes, spiders, cockroaches, beetles, moths, flies, and mosquitoes (Wilson et al., 2023), which may introduce various environmental bacteria into their systems.

The role of reptiles as asymptomatic carriers of *Salmonella* spp. has been widely documented. Marín et al. (2021) observed that nearly half of sampled pet reptiles carried *Salmonella*, with many strains exhibiting multidrug resistance, posing a significant zoonotic risk to pet owners and handlers. Similarly, Saleha et al. (2015) highlighted the prevalence of *Salmonella* in house geckos across multiple regions, emphasizing their role as zoonotic reservoirs. In Southeast Asia, Nguyen et al. (2021) identified *Salmonella Weltevreden* in wild geckos, including *Hemidactylus frenatus* and *Hemidactylus platyurus*, underscoring the significance of geckos as natural reservoirs for *Salmonella* in urban areas. The asymptomatic nature of infection in geckos aligns with our findings, suggesting that these reptiles may facilitate bacterial spread within household environments (Al-Taii et al., 2017).

The detection of *Salmonella* in the fecal samples of these house geckos highlights their role in potentially spreading zoonotic pathogens. While asymptomatic, their behavior—such as indiscriminate defecation—can lead to environmental contamination, particularly in households where geckos have access to surfaces near food and water storage areas (Ariffin et al., 2016). The identification of *Salmonella enterica* in house geckos within Makassar presents a significant public health consideration. Although this study does not advocate for the eradication of gecko populations, it underscores the importance of preventive sanitation measures to reduce zoonotic transmission risks. Regular cleaning of household areas where geckos reside, along with proper food storage practices, is crucial for reducing reptile-associated *Salmonella* transmission (RAS), as Corrente et al. (2017) found that pet owners who neglected hygiene practices, such as hand washing after handling reptiles, faced a significantly higher risk of pathogen exposure.

Public awareness about the potential zoonotic risks posed by house geckos could be beneficial, especially in urban settings with high gecko populations. Preventive practices, such as hand hygiene, food handling precautions, and regular cleaning of high-contact surfaces, can reduce the likelihood of bacterial transmission from gecko feces to humans. Future studies should investigate the seasonal prevalence of *Salmonella* spp. and other pathogens in urban gecko populations to inform more effective public health strategies.

Study Limitations

This study has several limitations that may affect the generalizability of its findings. First, the sample size of 50 geckos, though providing preliminary insights, may not fully represent the house gecko populations in Makassar or other urban settings. Additionally, the sampling was limited to five districts within Makassar City, which may not capture variability across different urban and suburban environments. The study was also conducted over a limited timeframe, potentially overlooking seasonal variations in bacterial prevalence. Lastly, limitations in culturing techniques may have affected bacterial recovery, potentially leading to underestimation of bacterial prevalence in gecko samples. Future studies with larger, more diverse samples, and improved detection methods are needed to validate and expand upon these findings.

Conclusion

This study identifies house geckos in Makassar City as potential carriers of zoonotic bacteria, specifically *Salmonella enterica* ssp. *enterica*, underscoring a notable public health concern in urban residential areas. Although only one positive case of *Salmonella* was observed, the findings highlight the need for awareness about food contamination risks from gecko feces.

Preventive measures, such as maintaining cleanliness in food preparation areas and limiting gecko access to sensitive locations, are essential for reducing transmission risks. Further research is encouraged to examine seasonal pathogen prevalence among house geckos and investigate additional zoonotic pathogens they may carry, contributing to a deeper understanding of the public health implications of household reptiles.

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Conflict of Interest
We certify that there is no conflict of interest with any financial, personal, or other relationships with people or organizations related to the material discussed in this manuscript.

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