Pakistan J. Zool., pp 1-4, 2024. **DOI**: https://dx.doi.org/10.17582/journal.pjz/20231203103210

Short Communication

Effect of Ivermectin and Permethrin on *Sarcoptes scabiei* in Indigenous Rabbits (*Oryctolagus cuniculus*)

Ateeq Ullah[1], Kamran Khan[1]*, Muhammad Shuaib[2]*, Ziual Islam[1], Abubakar Sufyan[3], Shahrood Ahmed Siddiqui[4], Muhammad Ismail Khan[5], Obaid Ullah[6] and Muhammad Shahkar Uzair[7]

[1]*Department of Basic and Applied Zoology, Shaheed Benazir Bhutto University, Sheringal, Dir (U), KP, Pakistan*
[2]*Arid Zone Small Ruminants Research Institute, Ghulam Banda, Kohat, Pakistan.*
[3]*Department of Livestock and Poultry Production, Bahauddin Zakariya University, Multan, Pakistan.*
[4]*Vaccine Production Unit Sindh Tandojam, Livestock and Fisheries Department Government of Sindh.*
[5]*Department of Zoology, Islamia College Peshawar.*
[6]*Department of Veterinary Clinical Sciences, Faculty of Veterinary and Animal Sciences, University of Poonch Rawalakot*
[7]*Department of Poultry Science, Faculty of Animal Husbandry and Veterinary Sciences, The University of Agriculture, Peshawar, Pakistan*

ABSTRACT

Sarcoptic mange infestation is a significant constraint in commercial rabbit rearing due to its detrimental effects on rabbit growth, productivity, and wool quality. In this study, the effectiveness of ivermectin and permethrin against 39 naturally infected *S. scabiei* rabbits (both sexes; age, 1-2 years) was evaluated. The infected rabbits were divided into a low-infestation group (n = 16 rabbits), a medium-infestation group (n = 11 rabbits), and a severe-infestation group (n = 9 rabbits) based on the severity of *S. scabiei* infestation. In the moderate group, ivermectin was given to 5 infected rabbits subcutaneously (200 µg kg^{-1} body weight), while permethrin (applied topically on lesions) was given to 4 infected rabbits at weekly intervals. Similarly, each of the 4 infested rabbits of the severely infected group was given ivermectin and permethrin, respectively. Likewise, each of the 8 rabbits in the low-infested group was given ivermectin and permethrin, respectively. In addition, for comparison 3 infected (1 selected from each group) and 3 healthy rabbits were designated as infested controls and negative control (no treatment was given), respectively. Before treatment, all infected rabbits have intense pruritus and a high degree of alopecia and crust formation. Notably, viable mites and their eggs were found microscopically. The response rate of the severely infected rabbits was slower after 1st treatment dose than the medium group. However, a significant reduction in the severity of mange infestation resulted in both groups after 2nd dose. Moreover, 80-90% of the cutaneous lesions recovered in rabbits received the permethrin group. All rabbits of the moderate group completely recovered after 3rd treatment dose. While all rabbits of the severely infected group recovered completely after 4th dose. It was concluded that both ivermectin and cost-effective permethrin are equally important in the control of mange infestation in rabbits.

Article Information
Received 03 December 2023
Revised 10 June 2024
Accepted 19 June 2024
Available online 02 October 2024 (early access)

Authors' Contribution
AU, KK: Designed this study, carried out the experiments, measurements, and drafted the manuscript. ZI: Participated in the study's design, coordination, and paper writing. MS: Data curation, statistical analysis, original draft preparation, editing and reviewing, and validation. AS, SAS, MIK, OU, MSU: Manuscript writing, editing and reviewing.

Key words
Ivermectin, Permethrin, *Sarcoptic scabiei*, Rabbit, Alopecia, Eye

* Corresponding author: shoaibwzr@gmail.com, dr.kamran@sbbu.edu.pk
0030-9923/2024/0001-0001 $ 9.00/0

In Khyber Pakhtunkhwa, where rabbit farming is still relatively new, there's a noticeable shift in consumer preferences towards rabbit meat (Khan *et al*., 2014). This shift is largely driven by the meat's high protein content (Khan *et al*., 2016) and its beneficial polyunsaturated fatty acids (Khan *et al*., 2018). The conducive agro-climatic conditions and availability of suitable feed resources in areas like Khyber Pakhtunkhwa have provided a favorable environment for rabbit farming (Khan *et al*., 2017a, b).

This advantageous setting has facilitated the growth of rabbit farming in the region, leading to a transition from small-scale family consumption to medium and large-scale commercial production operations (Khan *et al*., 2021). However, despite the promising prospects of rabbit farming, challenges such as *Sarcoptic* mange infestation pose significant economic constraints on farm animals (De and Dey, 2010). *Sarcoptes scabie*s (Acari: Sarcoptidae) is a ubiquitous ectoparasite affecting more than 100 mammalian species globally (Alasaad *et al*., 2011a). Scabies, caused by *S. scabiei* mites, is a disease with global significance, impacting both human and animal populations (Walton *et al*., 2004). The highly contagious nature of scabies can lead to the spread of the disease on farms, with a single case having the potential to rapidly spread within crowded populations (McCarthy *et al*., 2004), which may entail devastating mortality in wild and farm animals (Radostits *et al*., 2006), with huge economic losses (Dagleish *et al*., 2007), affecting the world animal trade (Alasaad *et al*., 2011b). Sarcoptic mange has been recognized as an emerging infectious disease of rabbit colonies caused by *S. scabiei* (Mitra *et al*., 2014). Though the disease is considered to be less dangerous in the initial phase, however, in neglected cases the condition is associated with serious economic losses (Kachhawa *et al*., 2013). Numerous studies have been conducted against *S. scabiei* in farm animals, nevertheless, to the best of our knowledge, no study has been reported of *S. scabiei* infestation in indigenous rabbits of Pakistan. Therefore, it is imperative to know the efficacy of drugs used in their treatment is critical for effective disease control. The current study was conducted to evaluate the efficacy of two commonly used therapeutic agents i.e. ivermectin and permethrin against *S. scabiei* in indigenous rabbits.

Materials and methods

A total of 39 indigenous rabbits, of mixed gender and aged between 1 to 2 years, were found positive for *S. scabiei* through skin scraping examination. These infected rabbits were then categorized into 3 groups based on the level of severity of their infections: low (L; n = 16), medium (M; n = 11 rabbits), and severe (S, n = 9 rabbits). Half of the rabbits in the L group were treated with ivermectin (MI; 200 µg kg^{-1} body weight) injected subcutaneously, whereas the other half by permethrin cream (MP; Lotrix®; 5% w/w), applied topically on the cutaneous lesion. Similarly, 6 rabbits in the M group were treated with ivermectin (SI; 200 µg kg^{-1} body weight) injected subcutaneously, whereas the other 5 were by topical application of permethrin cream (SP; Lotrix®; 5% w/w). Likewise, in the S group, four infected rabbits were treated with ivermectin and 5 were treated with permethrin cream, respectively. All treatments were repeated at weak intervals till the complete recovery of infected rabbits. Rabbits in each sub-group were housed individually per cage. In addition, for comparison 3 infected rabbits (1 from each group) were kept as infested control, and 3 healthy rabbits were kept in a separate group as a negative control with no treatment. Before treatment, infected rabbits were examined clinically for the presence of cutaneous lesions on the entire body and then examined post-treatment weekly till the complete recovery of the rabbits. Diagnosis for *S. scabiei* was performed by standard procedure of skin scrapping as reported by Soulsby (1982) at weekly intervals. Briefly, the sample (0.5 g) was collected through scalpel blade in petri dish from the affected areas such as the mouth, nose, eyelids, and area around the external genitalia by using deep skin scraping materials of each infected rabbit, and subjected to digestion with 10% KOH solution. The digested materials were centrifuged and sediments were examined under low (10X) power of microscope (ISH 500) for the detection of mange agent as well as its morphology.

Results and discussion

Morphologically, *S. scabiei* mites were observed to have a rounded body with shorter legs, along with several transverse rigid and triangular scales on the dorsal part as described by (Urquhart *et al*., 1996). It's noted in the literature that *S. scabiei* and *Psoroptes cuniculi* are the predominant mite species affecting rabbits. However, minor cases of infestation by *Demodex, Malassezia*, and *Cheyletiella* species have also been reported (Arsalan *et al*., 2008; Panigrahi *et al*., 2014). Interestingly, our findings align with those of Kaya *et al*. (2010), who also reported *S. scabiei* infestation in New Zealand white rabbits. This consistency in findings across different studies underscores the significance of *S. scabiei* as a common parasite affecting rabbits and emphasizes the importance of effective management and treatment strategies to control infestations and maintain rabbit health.

Table I presents data on the clinical manifestations observed in rabbits infected with *S. scabiei* before the initiation of treatment. Common signs included pruritus (itchiness), lichenification (thickened skin), alopecia (hair loss), and the presence of dry, scaly crusts. These clinical signs were observed primarily on the nose, around the eyes, ears, paws, and external genitalia of the infected rabbits. Specifically, severely infected rabbits exhibited more intense itching, a severe degree of hair loss, and extreme crust formation compared to rabbits with lower infestation levels. Additionally, infected rabbits were lethargic, with disfigured faces and rough body coats. The severity of irritation prompted rabbits to scratch the lesions with their

Table I. Clinical manifestation and parasitological examination of the mange-infested rabbits prior to treatment.

Groups	Category	Gross lesion	Score
I	Low*	Lesions are confined to the mouth region	+
II	Medium**	Lesions extended to facial area including ear	++
III	Severe***	Lesions covered facial area, external genitalia and paws	++++

*Absence of crust formation and no sign of erythema. **the sign of itching and crust formation are moderate. ***Greater intensity of itching, severe degree of alopecia, erythema of the skin, and extreme crust formation.

front paws, exacerbating the discomfort and potentially leading to further skin damage. On the other hand, the degree of mange infestation was moderate in the medium-infected groups. The feed intake was also reduced in the mange-infested rabbits. Willis *et al*. (2006) reported that *Sarcoptes* mite burrows in the stratum corneum of the host's skin during infestation for the entire life cycle process. As the infestation preceded, the number of mites significantly increased triggering intense itching, the rapid development of cutaneous inflammation and crusted skin lesions as well as general erythema of the skin (Stewart *et al*., 2011; Mitra *et al*., 2014). The findings of the present study, which include high pruritus (itching), scab formation on the skin, and lichenification in specific areas, are consistent with the observations made by Panigrahi *et al*. (2014). In their study on New Zealand rabbits, similar clinical signs were noted, including itching, scab formation, and lichenification in specific anatomical areas such as the mouth area, edge of the pinnae (ears), lower jaw, and limbs.

Before the initiation of treatment, mange-infested rabbits exhibited a higher degree of pruritus (itching), and skin scrapings revealed the presence of numerous viable *S. scabiei* mites, and their eggs per slide. This indicates a heavy infestation burden in these rabbits. Notably, the recovery rate, characterized by crust shedding and intensity of itching, was slower in severely mange-infested rabbits compared to those with moderate infestation levels in both treatment groups on the 7th day post-treatment. This suggests that the severity of the infestation influenced the response to treatment, with more severe cases requiring more time to show improvement. However, with continued treatment, a reduction in the severity of mange infestation was observed in all groups after the second dose. Approximately 80-90% of the cutaneous lesions had recovered in rabbits treated with permethrin after the second dose. Furthermore, rabbits with moderate mange infestation fully recovered in response to both treatment groups after receiving the third dose. Finally, rabbits in the severe infestation group achieved complete recovery by the 28th day post-treatment. This indicates that while severe cases may take longer to resolve, with appropriate treatment, significant improvement and eventual full recovery can be achieved. These findings underscore the effectiveness of both ivermectin and permethrin in treating *S. scabiei* infestation in rabbits and highlight the importance of continued monitoring and treatment to ensure complete resolution of the condition. Moreover, the microscopic examination of the skin scrapping revealed the presence of neither *S. scabiei* nor their eggs in all rabbits. A previous research study reported the successful use of ivermectin, doramectin, benzyl benzoate, and pheniramine maleate in mange infestation in rabbits (Kaya *et al*., 2010; Kachhawa *et al*., 2013). Ivermectin possesses antiparasitic and immunomodulatory properties. By attaching to glutamate-gated chloride channels in nerve and muscle, ivermectin inhibits synaptic transmission in invertebrates, including mosquitoes. This causes hyperpolarization, paralysis, and invertebrate mortality (Meyers *et al*., 2015). Permethrin affects on insects neurological systems by interfering with sodium channels, disrupting neuron activity and causing muscles to spasm, resulting in paralysis and death. Permethrin functions as a moderate repellent and effective via touch or ingestion (Tomlin, 2006). The successful outcomes reported in these studies, along with the findings of the present study, contribute to the body of evidence supporting the use of these treatments in the management of mange infestation in rabbits.

Conclusion

The present study underscores the successful therapeutic management of *S. scabiei* mite infestation in rabbits experiencing intense itching, cutaneous inflammation, and crusted skin lesions. The findings demonstrate that both permethrin, a cost-effective treatment option, and ivermectin, which may be relatively more expensive, are equally crucial for controlling sarcoptic mange infestation in rabbits. The effectiveness of these treatments is crucial for alleviating the discomfort and welfare concerns associated with mange infestation in affected rabbits.

Acknowledgement

We acknowledge the Department of Zoology, Shaheed Benazir Bhutto University, Sheringal, Dir (U), KP, Pakistan for the provision of an experimental and technical facilities. No formal funding was available for

this study.

Ethical statement

The experimental work was approved by the Board of Studies meeting (dated 04/01/2021), and the Ethical Review Committee of the Department of Zoology, Shaheed Benazir Bhutto University, Sheringal, Dir (U), KP, Pakistan. All the measures and tools were considered to minimize the pain and discomfort of rabbits during the conduction of this experiment.

Statement of conflict of interest

The authors have declared no conflict of interest.

References

Alasaad, S., Oleaga, A., Casais, R., Rossi, L., Molinar, A., Soriguer, R.C. and Gortazar, C., 2011a. *Parasites Vectors*, **4**: 151. https://doi.org/10.1186/1756-3305-4-151

Alasaad, S., Walton, S., Rossi, L., Bornstein, S., Abu-Madi, M., Soriguer, R.C., Fitzgerald, S., Zhu, X.Q., Zimmermann, W., Ugbomoiko, U.S., Pei, K.J.C. and Heukelbach, J., 2011b. *Int. J. Infect. Dis*., **15**: 294-297. https://doi.org/10.1016/j.ijid.2011.01.012

Arslan, H.H., Acici, M., Umur, S. and Hokelek, M., 2008. *Turk. Parazitol. Derg.*, **32**: 244-246.

Dagleish, M.P., Ali, Q., Powell, R.K., Butz, D. and Woodford, M.H., 2007. *J. Wildlife. Dis*., **43**: 512-517. https://doi.org/10.7589/0090-3558-43.3.512

De, U.K. and Dey, S., 2010. *Trop. Anim. Hlth. Prod*., **42**: 1663-1668. https://doi.org/10.1007/s11250-010-9618-y

Kachhawa, J.P., Kachhawa, S., Srivastava, M., Chahar, A. and Singh, N., 2013. *Intas Polivet*., **14**: 306-308.

Kaya, D., Inceboz, T., Kolatan, E., Guneli, E. and Yilmaz, O., 2010. *Vet. Ital.*, **46**: 51-56.

Khan, S., Khan, K., Shah, S.U. and Ahmad, N., 2014. *Sarhad J. Agric*., **30**: 369-373.

Khan, K., Khan, S., Khan, R., Sulatan, A., Khan, N.A. and Ahmad, N. 2016. *Trop. Anim. Hlth. Prod*., **48**: 1661-1666. https://doi.org/10.1007/s11250-016-1140-4

Khan, K., Khan, S., Khan, N.A., Khan, I. and Ahmad, N., 2017a. *J. Anim. Pl. Sci*., **27**: 2017.

Khan, K., Khan, S., Khan, N.A. and Ahmad, N., 2017b. *J. Anim. Pl. Sci*., **27**: 75-81. https://doi.org/10.1007/s12665-015-5127-7

Khan, K., Khan, S., Khan, N.A. and Ahmad, N., 2018. *Pakistan J. Zool*., **50**: 2037-2043. https://doi.org/10.17582/journal.pjz/2018.50.6.2037.2043

Khan, K., Aziz, K., Khan, N.A., Khan, S. and Ayasan, T., 2021. *J. Hellenic. Vet. med. Soc*., **72**: 3511-3518. https://doi.org/10.12681/jhvms.29404

McCarthy, J., Kemp, D., Walton, S. and Currie, B., 2004. *Post Grad. med. J.,* **80**: 382-387. https://doi.org/10.1136/pgmj.2003.014563

Meyers, J.I., Gray, M., Kuklinski, W., Johnson, L.B., Snow, C.D. and Black, W.C., 2015. *J. exp. Biol*., **218**: 1478–86. https://doi.org/10.1242/jeb.118570

Mitra, J., Shikari, R.N., Das, A.K., Roy, B.B. and Mitra, 2014. *Exp. Anim. med. Res*., **4**: 116-120.

Panigrahi, P.N., Mohanty, B.N., Gupta, A.R., Patra, R.C. and Dey, S., 2014. *J. Parasitol. Dis*., **40**: 1091-1093. https://doi.org/10.1007/s12639-014-0631-3

Radostits, O.M., Gay, C.C., Hinchcliff, K.W. and Constable, P.D., 2006. *Veterinary medicine*. W.B. Saunders, London. pp. 1610–1611

Soulsby, E.J.L., 1982. *Helminths, arthropods and protozoa of domesticated animals* 7th ed. Baillaire Tindall London, UK. pp. 482-486.

Stewart, T.G.B., Tom, N.M., Craig, A.W., Alasdair, J.N. and John, F.H., 2011. *PLoS One*, **9**: e24402.

Tomlin, C.D.S., 2006. *The pesticide manual: A world compendium*, 14th ed. British Crop Production Council: Alton, England., pp. 813-814.

Urquhart, G.M., Armour, J., Duncan, J.L., Dunn, A.M. and Jennings, F.W., 1996. *Veterinary parastology* 2nd ed. Ames, Iowa, USA. pp. 39-40.

Walton, S.F., Dougall, A., Pizzutto, S., Holt, D., Taplin, D., Arlian, L.G., Morgan, M., Currie, B.J. and Kemp, D.J., 2004. *Int. J. Parasitol*., **34**: 839-849. https://doi.org/10.1016/j.ijpara.2004.04.002

Willis, C., Fischer, K., Walton, S.F., Currie, B.J. and Kemp, D.J., 2006. *Am. J. trop. Med. Hyg*., **75**: 683-687. https://doi.org/10.4269/ajtmh.2006.75.683