ESVP

Eurasia Specialized Veterinary Publication

International Journal of Veterinary Research and Allied Science

2022, Volume 2, Issue 2, Page No: 14-20

Available online at: www.esvpub.com/

Effectiveness of Synthetic Pyrethroids Against Camel Ticks *Hyalomma dromedarii* (Acari: Ixodidae) in Saudi Arabia

Aziz Al Thabiani[1]*, Chellasamy Panneerselvam[1], Mohammed Ali Alshehri[1], Khalid Ali Asiry[2], Majed Alsaif[3], Yasser Alhowity[4]

[1]Department of Biology, Faculty of Science, University of Tabuk, Tabuk, Saudi Arabia.
[2]Department of Agriculture, Faculty of Environmental Science, King Abdulaziz University, Jeddah, Saudi Arabia.
[3]Department of Vector Control, Public Health Department, Ministry of Health, Hail, Saudi Arabia.
[4]Tabuk Municipality, Tabuk, Saudi Arabia.

***E-mail** ✉ aalthbyani@ut.edu.sa

ABSTRACT

Arthropods serve as highly efficient vectors for a wide range of life-threatening pathogens, including parasites and viruses, worldwide. *Hyalomma dromedarii* Koch is the primary tick species that infests camels. In this study, we evaluated the insecticidal activity of commercially available deltamethrin (DM), cypermethrin (Cym), and α-cypermethrin (α-Cym) against adult *H. dromedarii* using in vitro immersion bioassays. Fresh concentrations of each synthetic insecticide (25, 50, 100, and 150 ppm) were prepared for testing. In the toxicity assessment, DM-treated ticks showed higher mortality compared to Cym, with α-Cym also being effective but less so than DM. Mortality rates increased at 48 hours post-treatment, compared to 24 hours, with LC_{50} values at 24 hours for DM, Cym, and α-Cym being 66.93, 129.72, and 81.08 ppm, respectively. At 48 hours, the LC_{50} values were 4.23, 37.25, and 3.12 ppm. These results indicate that DM and α-Cym are more potent than Cym against adult *H. dromedarii*.

Keywords: Toxicity, *Hyalomma dromedarii*, Pyrethroids, Insecticides, Ticks

Received: 02 June 2022
Revised: 08 September 2022
Accepted: 10 September 2022

How to Cite This Article: Al Thabiani A, Panneerselvam C, Alshehri MA, Asiry KA, Alsaif M, Alhowity Y. Effectiveness of Synthetic Pyrethroids Against Camel Ticks *Hyalomma dromedarii* (Acari: Ixodidae) in Saudi Arabia. Int J Vet Res Allied Sci. 2022;2(2):14-20.

Introduction

Ticks rank second among arthropod vectors responsible for transmitting rickettsial, viral, bacterial, and protozoan pathogens, following mosquitoes. *Hyalomma dromedarii* is the dominant tick species infesting camels, with infection rates reaching approximately 89% in Sudanese camels [1], 95.6% in those from Sinai [2], and 57.13% in camels from Benha and Belbis, Egypt [3-5]. This species thrives in desert and semi-desert regions, ranging from northwestern India to the Arabian Peninsula [6]. As a member of the Ixodidae family [7], *H. dromedarii* plays a crucial role in the transmission of various diseases globally [8, 9]. While adult ticks primarily infest camels, cattle may also serve as hosts, though camels remain the primary target for both ticks and mites. The Arabian camel (*Camelus dromedarius*), the smallest among the three recognized camel species, is an essential provider of various animal products. These camels frequently encounter a broad range of external parasites that compromise their health and productivity, making effective control strategies vital.

The most common and efficient method to manage tick infestations in humans, livestock, and animals involves the use of acaricides and repellents. However, the repeated application of these compounds at suboptimal doses has led to increasing resistance among tick populations. The extensive use of synthetic pesticides and repellents targeting veterinary parasites and disease-carrying arthropods has also complicated control measures.

Additionally, synthetic insecticides have become more widely employed in the management of agricultural pests, urban infestations, and mosquito populations. This study aimed to highlight key ectoparasites affecting camels (*Camelus dromedarius*) in Saudi Arabia. Given the challenges posed by tick resistance and the high cost of conventional antiparasitic drugs, alternative approaches such as therapeutic plant-based treatments have gained attention as potential control measures. This investigation specifically focused on assessing tick populations in northern and western regions of Saudi Arabia, including Tabuk, Taif, and Hail, while also evaluating the effectiveness of selected synthetic pyrethroids against *H. dromedarii* using the adult immersion technique (AIT).

Materials and Methods

Tick collection and identification

A total of 500 hard ticks were gathered from camel farms located in Tabuk, Taif, and Hail, Saudi Arabia, between September 2016 and December 2018. The collection sites included Amman Road (28°53' N, 35°54' E), Madinah Road (28°26' N, 37°11' E), Duba Road (28°24' N, 36°32' E), and the Industrial Area (28°24' N, 36°32' E) in Tabuk, as well as Hail (27°53' N, 41°74' E) and Taif (21°23' N, 40°48' E). Ticks obtained from infested camels were transported to the Medical Entomology and Toxicology Laboratory at the Department of Biology, University of Tabuk, for taxonomic classification. Identification was conducted using a standard identification key [10]. After classification, the tick specimens were kept under controlled laboratory conditions for further bioassay evaluations.

Insecticides

The synthetic pyrethroids used in the study included 5% deltamethrin (DM), 10% cypermethrin (Cym), and α-cypermethrin (α-Cym), all of which were sourced from the local market in Saudi Arabia. Various concentrations (25, 50, 100, and 150 ppm) were freshly prepared using distilled water for bioassay experiments targeting ticks, employing the adult immersion technique.

Experimental design and adult immersion test (AIT)

The adult immersion test was performed following the protocols outlined by Drummond *et al*. [11] and Sharma *et al*. [12]. A total of 200 randomly selected ticks were divided into 4 groups, with each group containing 20 specimens. The control group was treated with distilled water. Each experiment was conducted in duplicate, and tick mortality was recorded at 24 and 48 hours post-treatment.

Statistical analysis

Descriptive statistical analysis was carried out to determine the mean and standard deviation. Data processing and statistical evaluations were performed using GraphPad Prism 4 and SPSS software (version 16).

Results and Discussion

Ticks classification

A total of 500 hard ticks were gathered from the designated study locations. Among the collected specimens, *H. dromedarii* was the most prevalent species **(Table 1; Figure 1)**. This species accounted for 95% of the total ticks, with 55% being males and 40% females. Other identified species included *Hyalomma truncatum*, making up 2% (with an equal distribution of males and females), and *Hyalomma rufipes*, comprising 1% (only males). Additionally, 2% of the collected ticks were unidentified soft ticks. The distribution of these tick species appeared to be influenced by temperature, humidity, and rainfall patterns. Due to the availability of sufficient specimens for further investigation, the focus of this study was placed on *H. dromedarii*.

Table 1. Total number of ticks collected from different regions of Saudi Arabia

Locations	Species	No. of male	No. of female
Tabuk	*H. dromedarii*	55	40
	H. truncatum	1	1
	H. rufipes	1	0

Taif	*H. dromedarii*	31	0
	H. truncatum	4	0
	Unknown	2	2
Hail	*H. dromedarii*	24	1
	H. truncatum	1	12
	H. rufipes	2	6

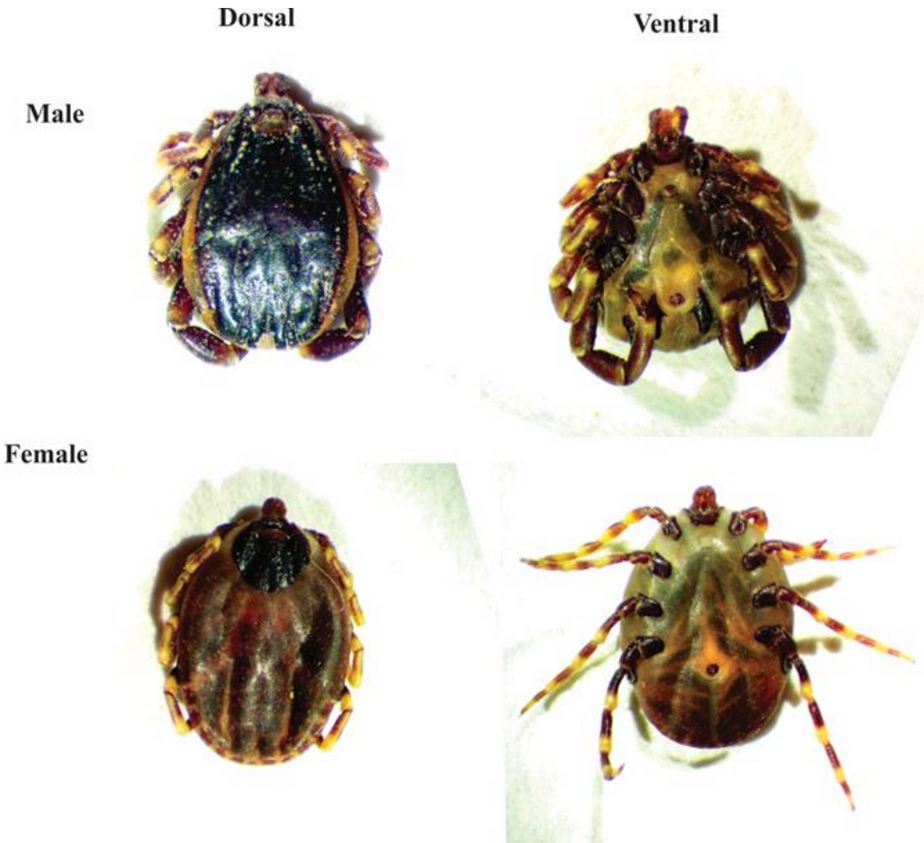

Figure 1. *H. dromedarii* collected from the Tabuk region, Saudi Arabia.

Insecticidal effect of DM, Cym, and α-Cym

Ticks are recognized as the second most significant vectors, after mosquitoes, in the transmission of pathogens to both humans and domestic animals [13]. New findings confirm that *H. dromedarii* is the predominant tick species affecting dairy animals in the selected study locations. The extensive use of synthetic pyrethroids as acaricides for tick control has contributed to the emergence of acaricide resistance. Resistance in tick populations poses a critical challenge to the effectiveness of cypermethrin against these vectors. The objective of this study was to assess the comparative effectiveness of DM, Cym, and α-Cym against *H. dromedarii* under laboratory conditions. All tested synthetic pyrethroids—5% deltamethrin, 10% cypermethrin, and 6% α-cypermethrin—exhibited acaricidal activity against ticks. The most effective concentration was 150 ppm after 48 hours of post-treatment, showing a greater impact compared to 24 hours. A noticeable increase in tick mortality was recorded 48 hours after exposure to synthetic pyrethroids compared to the earlier observation period (24 hours) **(Figures 2 and 3)**. Mortality rates demonstrated a dose-dependent response. Graphs illustrating the relationship between acaricide concentrations and probit toxicity were used to determine LC_{50} values **(Figures 2-4)**. The minimum lethal concentration (MLC) required to achieve 95% acaricidal effectiveness was 150 ppm at 48 hours post-treatment, demonstrating superior efficacy compared to Cym **(Table 2)**.

The LC_{50} values at 24 hours post-treatment for DM, Cym, and α-Cym were 66.93, 129.72, and 81.08 ppm, respectively, while after 48 hours, they were 4.23, 37.25, and 3.12 ppm **(Table 2)**. Among the three compounds, Cym was determined to be the least effective, whereas DM and α-Cym exhibited superior acaricidal activity.

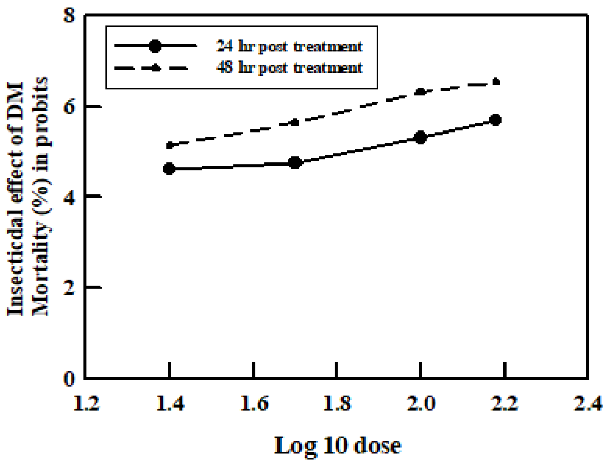

Figure 2. Mortality rate of DM following 24 and 48 hours of post-treatment, demonstrating its insecticidal effectiveness.

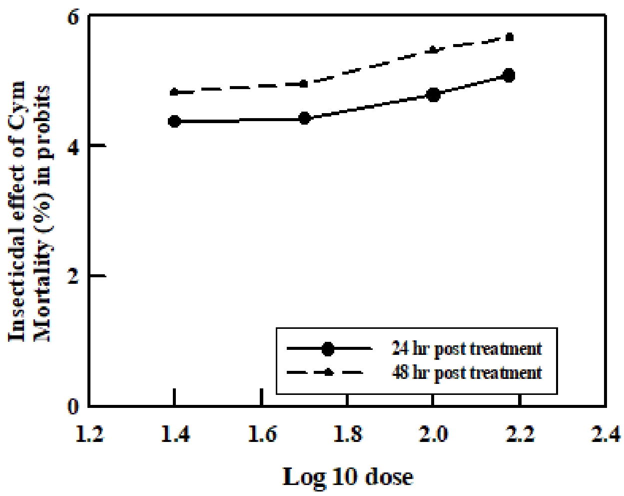

Figure 3. Mortality effect of Cym at 24 and 48 hours post-treatment, highlighting its insecticidal potency.

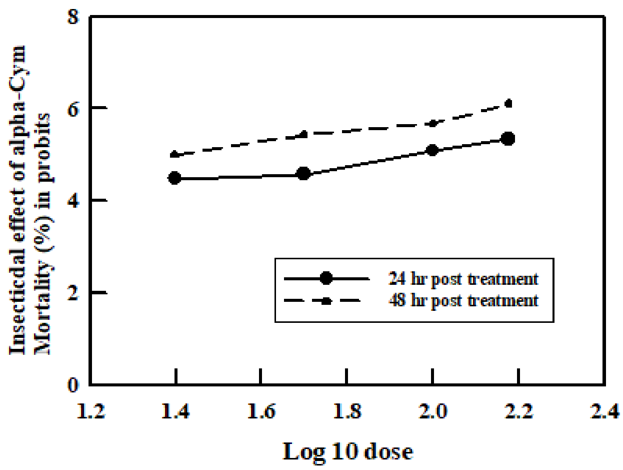

Figure 4. Mortality impact of α-Cym following 24 and 48 hours of post-treatment, demonstrating its insecticidal effectiveness.

Table 2. Acaricidal activity of selective insecticides against *H. Dromedarii*

Post-treatment	Acaricides tested	Slope	$LC_{50\ ppm}$ (95% LCL-UCL)	$LC_{90\ ppm}$ (95% LCL-UCL)	Regression equation	χ2
24 h	DM	1.39 ± 0.14	66.938 (50.311-81.201)	210.340 (177.134-270.432)	$y = 0.598 + 0.009x$	0.429
	Cym	0.91 ± 022	129.729 (106.034-176.505)	347.403 (263.920-562.978)	$y = 0.764 + 0.006x$	0.281
	α-Cym	1.16 ± 0.17	81.087 (62.844-99.449)	255.286 (206.788-355.772)	$y = 0.597 + 0.007x$	0.703
48 h	DM	1.85 ± 0.12	4.230 (20.943-19.773)	95.222 (82.219-114.873)	$y = 0.060 + 0.014x$	2.350
	Cym	1.14 ± 0.17	37.259 (6.014-56.096)	209.870 (171.096-302.884)	$y = 0.277 + 0.007x$	0.982
	α-Cym	1.32 ± 0.16	3.127 (34.911-24.346)	140.501 (118.407-180.540)	$y = 0.277 + 0.007x$	1.580

For our insecticidal efficacy study, we concentrated on *H. dromedarii* due to its accessibility. Farmers in the selected study regions have reported the frequent use of locally available acaricides DM and Cym, but often without ensuring the correct dosage, resulting in suboptimal effectiveness of the marketed products for tick management.

Our findings align with previous studies showing that DM is more potent against ticks, demonstrating a 70% mortality rate at a dose of 25 ppm, compared to Cym [14]. Furthermore, Batiste Alentron *et al*. [15] observed that Cym was more toxic than fenvalerate to both the larval and adult stages of Drosophila melanogaster. Tick age and condition significantly influence the variability in results [16], but by standardizing these factors in laboratory settings, we obtained consistent findings. Insecticide stock solutions were prepared by dissolving them in 100% methanol, and the working concentrations were made using double distilled water (DDH2O). The use of an appropriate organic solvent is crucial for preparing the dilutions, as it aids in the absorption of active compounds onto the biological target surfaces and helps the acaricide penetrate the insect exoskeleton [12].

In our AIT, LC_{50} values were calculated based on toxicity data, which provided reliable results since this parameter had less variation due to the large sample size of ticks used. Past studies have noted significant variation in AIT values when small sample sizes were used, resulting in unreliable data [16]. Tick populations exhibit considerable potential for developing resistance due to their behavioral traits, and resistance to various active compounds has been reported globally in tick populations [17]. Sajid *et al*. [18] showed that the pour-on formulations of Cym were more effective on Hyalomma anatolicum in vivo.

To the best of our knowledge, this study is the first to report on the distribution and prevalence of ticks in Tabuk, Hail, and Taif, Saudi Arabia, a region characterized by arid conditions and low annual rainfall. *H. dromedarii* accounted for 95% of the tick species identified. This research provides important baseline data on ticks, which could aid in improving tick control strategies in arid countries around the world. We also observed that the efficacy of acaricides on adult male ticks resulted in 100% mortality at concentrations of one hundred fifty ppm and higher. Below this dose, no groups achieved complete mortality. The control group ticks remained alive even after 48 hours of treatment.

Conclusion

This study evaluated the acaricidal effectiveness of commercial formulations of DM, Cym, and α-Cym against *H. dromedarii* using the AIT method. The findings revealed variability in tick mortality across the different insecticide formulations. These results highlight the urgent need for livestock farmers to reassess the dosages of synthetic insecticides they use. Furthermore, alternative and more effective tick control strategies should be developed over time to address the issue.

Acknowledgments: The author expresses gratitude to the Deanship of Scientific Research, University of Tabuk, for financial support (grant no. S0012-1438). Thanks are also extended to the Department of Biology, Faculty of Sciences, Saudi Digital Library, and University Library. Additionally, appreciation is given to the Ministry of Health, Saudi Arabia, for their continuous support in advancing our research.

Conflict of Interest: None

Financial Support: This research was funded by the Deanship of Scientific Research, University of Tabuk, Saudi Arabia (Grant no. S0012-1438).

Ethics Statement: None

References

1. Elghali A, Hassan SM. Ticks (Acari: Ixodidae) infesting camels (*camelus dromedarius*) in Northern Sudan. Onderstepoort J Vet Res. 2009;76(2):177-85. doi:10.4102/ojvr.v76i2.43
2. Van Straten M, Jongejan F. Ticks (Acari: Ixodidae) infesting the Arabian camel (*camelus dromedarius*) in the Sinai, Egypt with a note on the acaricidal efficacy of Ivermectin. Exp Appl Acarol. 1993;17(8):605-16. doi:10.1007/BF00053490
3. Ramadan MY. Studies on some ectoparasites of camels. MSc thesis, Zagazig University (Benha Branch), Egypt; 1997.
4. Al-Ghamdi M, Aly MM, Sheshtawi RM. Antimicrobial activities of different novel chitosan-collagen Nanocomposite films against some bacterial pathogens. Int J Pharm Phytopharmacol Res. 2020;10(1):114-21.
5. Ashjaran A, Sheybani S. Drug release of bacterial cellulose as antibacterial Nano wound dressing. Int J Pharm Res Allied Sci. 2019;8(3):137-43.
6. Hoogstraal H. The epidemiology of tick-borne Crimean-Congo hemorrhagic fever in Asia, Europe, and Africa. J Med Entomol. 1979;15(4):307-417. doi:10.1093/jmedent/15.4.307
7. Barker SC, Murrell A. Systematics and evolution of ticks with a list of valid genus and species names. Parasitology. 2004;129(Suppl):S15-36. doi:10.1017/s0031182004005207
8. Guimarães JH, Tucci E, Barros-Batttesti DM. Ectoparasitos de importância veterinária permuta. 2001. (Accessed: 24 December 2020). Available from: https://permuta.bce.unb.br/produto/ectoparasitos-de-importancia-veterinaria/
9. Parola P, Raoult D. Ticks and tickborne bacterial diseases in humans: an emerging infectious threat. Clin Infect Dis. 2001;32(6):897-928. doi:10.1086/319347
10. Parola P, Paddock CD, Socolovschi C, Labruna MB, Mediannikov O, Kernif T, et al. Update on tick-borne Rickettsioses around the world: a geographic approach. Clin Microbiol Rev. 2013;26(4):657-702.
11. Drummond RO, Ernst SE, Trevino JL, Gladney WJ, Graham OH. *Boophilus annulatus* and *B. microplus*: laboratory tests of insecticides. J Econ Entomol. 1973;66(1):130-3. doi:10.1093/jee/66.1.130
12. Sharma AK, Kumar R, Kumar S, Nagar G, Singh NK, Rawat SS, et al. Deltamethrin and cypermethrin resistance status of *Rhipicephalus (Boophilus) microplus* collected from six agro-climatic regions of India. Vet Parasitol. 2012;188(3–4):337-45. doi:10.1016/j.vetpar.2012.03.050
13. Zhou J, Liao M, Ueda M, Gong H, Xuan X, Fujisaki K. Characterization of an intracellular cystatin homolog from the tick *Haemaphysalis longicornis*. Vet Parasitol. 2009;160(1–2):180-3. doi:10.1016/j.vetpar.2008.10.086
14. Sharma N, Singh V, Shyma KP, Parsani HR. Comparative efficacy of commercial preparation of Deltamethrin and Cypermethrin against *Ornithodoros* spp. of North Gujarat. J Parasit Dis. 2017;41(4):1139-42. doi:10.1007/s12639-017-0947-x
15. Batiste-Alentorn M, Xamena N, Velazquez A, Creus A, Marcos R. Studies on the toxicity of Cypermethrin and Fenvalerate in different strains of *Drosophila melanogaster* Meig. (Insecta: Diptera). Environ Res. 1987;43(1):117-25. doi:10.1016/S0013-9351(87)80063-4

16. Jonsson NN, Miller RJ, Robertson JL. Critical evaluation of the modified-adult immersion test with discriminating dose bioassay for *Boophilus microplus* using American and Australian isolates. Vet Parasitol. 2007;146(3-4):307-15. doi:10.1016/j.vetpar.2007.02.031
17. Alonso-Díaz M, Rodriguez-Vivas RI, Fragoso-Sanchez H, Rosario-Cruz R. Ixodicide resistance of the *Boophilus microplus* tick to ixodicides. Arch Med Vet. 2006;38(2):105-13. doi:10.4067/S0301-732X2006000200003
18. Sajid MS, Iqbal Z, Khan MN, Muhammad G. In vitro and in vivo efficacies of Ivermectin and Cypermethrin against the cattle tick *Hyalomma anatolicum anatolicum* (Acari: Ixodidae). Parasitol Res. 2009;105(4):1133-8. doi:10.1007/s00436-009-1538-2