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Efficacy of Synthetic Pyrethroids on Camel Ticks *Hyalomma dromedarii* "Acari: Ixodidae" in Saudi Arabia

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ABSTRACT

Arthropods are highly effective vectors for a number of life threatening pathogens, parasites, viruses etc., across the world. *Hyalomma dromedarii* Koch is the prominent tick species infesting camels. Therefore, in this research we studied the insecticidal efficacy of commercially available deltamethrin (DM), Cypermethrin (Cym) and α-Cypermethrin (α-Cym) in the fight against the adult of *H. dromedarii* through *in vitro* immersion bioassays. In this study, different concentrations of all selected synthetic insecticides (25, 50, 100, and 150 ppm) were freshly prepared. In toxicity assays, compared to Cym, adult tick mortality was found to be higher in DM followed by α-Cym treated ticks. The mortaltiy rates were increased after 48 h post-treatment of synthetic pyrethroids when compared with 24 h and the LC_{50} values for 24 h post-treatment with DM, Cym and α-Cym were 66.93, 129.72, and 81.08 ppm respectively, whereas that 48 h post-treatment were 4.23, 37.25, and 3.12 ppm. Our findings suggest that the DM and α-Cym were more effective against adult *Hyalomma dromedarii* than Cym.

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

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INTRODUCTION

Ticks are second-most among rickettsial vectors, bacterial, viral, and protozoan agents compared to mosquitoes. *Hyalomma dromedarii* was predominantly tick-infected camels, about 89% of Sudan camels [1] and 95.6% of Sinai camels were infected [2] and 57.13% in Benha and Belbis, Egypt [3-5]. It is distributed in deserts and semi-deserts from northwestern India to Arabia [6]. *Hyalomma dromedarii* belongs to family Ixodidae [7]; has played a leading role in transferring many diseases worldwide [8, 9]. Adult *Hyalomma dromedarii* infect chiefly camel. Cattle are also considered, but camels are the prime hosts of ticks ans mites. *Camelus dromedarius* (Arabian camel) is the smallest of the three species and are a significant source for variable animal products. Camels were exposed to wide spectrum of external parasites, which impair health and productivity directly and indirectly, and their active control is of pivotal importance.

The usual efficient method to reduce the menace by ticks to humans, animals, and livestock is to use the repellants and acaricides. However, the recurrent use, insufficient dose of compounds led to increasing resistances in ticks. Use of synthetic pesticides utilization and repellents for target veterinary pests and medical importance became progressively and more challenging. Also, synthetic insecticide applications had been

increased in controlling urban, agricultural pests as well as mosquitoes. In our investigation, the effort had been made for draw together some salient point concerning the significant ectoparasites of the camel (*Camelus dromedarius*) in Saudi Arabia. The development of tick resistances and high cost of the conventional ectoparasitic drugs have limited the control of veterinary parasites and hence led to the evaluation of therapeutic plants as an alternative source for controlling ticks. This present investigation aims to determine the ticks population in north and west parts (Tabuk, Taif, and Hail) of Saudi Arabia, and also we studied the efficacy of some potential synthetic pyrethroids against ticks using adult immersion techniques (AIT).

MATERIALS AND METHODS

Collection and identification of ticks

A total of 500 hard ticks were collected from the camel farms of Tabuk, Taif and Hail cities and the locations were 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 Industrial area (28°24'N, 36°32'E), Hail (27°53'N, 41°74'E) and Taif (21°23'N, 40°48'E).), Saudi Arabia from September 2016 to December 2018. The collected tick samples from infected camels were brought to Medical Entomology and Toxicology laboratory, Department of Biology, University of Tabuk for taxonomical identification using standard identification key [10]. Then, the identified ticks were maintained under laboratory conditions for bioassay studies.

Insecticides

The synthetic pyrethroids 5% deltamethrin (DM), 10% cypermethrin (Cym), and α-cypermethrin (α-Cym) were purchased from the local market, Saudi Arabia, and different concentrations (25, 50, 100, 150 ppm) were freshly prepared with distilled water for bioassay studies against ticks by adult immersion techniques.

Experimental groups and adult immersion test (AIT)

Following the method described by Drummond *et al.* [11] and Sharma *et al.* [12], AIT was conducted against ticks. Randomly 200 ticks were distributed into four groups with 20 specimens. Control was maintained with distilled water. All experiments were performed in duplicate. The mortality of ticks was observed after 24 h and 48 h post-treatment.

Statistical analysis

Data were analyzed descriptively for the mean and standard deviation. Statistical analyses were carried out using Graph Pad Prism 4 and SPSS software (16 version).

RESULTS AND DISCUSSION

Ticks classification

In this research, 500 hard ticks were collected from the selected study sites. Among the chosen study sites, the highest populations of tick specimens were *Hyalomma dromedarii* **(Table 1 and Figure 1)**. These included 95% of *Hyalomma dromedarii* (55% Male and 40% Female), others 2% included *Hyalomma truncatum* (1% male and female), and 1% *Hyalomma rufipes* (only male), and 2% unidentified soft ticks. The distribution of ticks was found to be related to temperature, relative humidity, and rainfalls. Because of the easy accessibility for further studies, we have focused on the species *Hyalomma dromedarii.*

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

Locations	Species	No. of male	No. of female
Tabuk	*Hyalomma dromedarii*	55	40
	Hyalomma truncatum	1	1
	Hyalomma rufipes	1	0
Taif	*Hyalomma dromedarii*	31	0
	Hyalomma truncatum	4	0
	Unknown	2	2
Hail	*Hyalomma dromedarii*	24	1
	Hyalomma truncatum	1	12
	Hyalomma rufipes	2	6

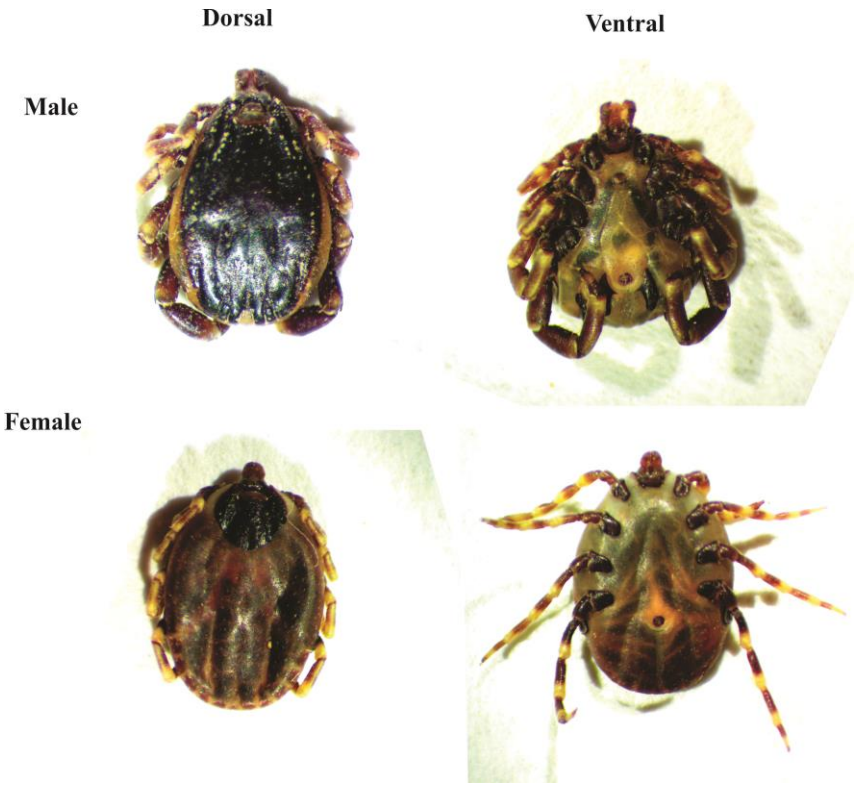

Figure 1. *Hyalomma dromedarii* collected from the Tabuk region, Saudi Arabia.

Insecticidal effect of DM, Cym, and α-Cym.

Besides mosquitoes, ticks are ranked second most vectors in terms of transmitting pathogens to domestic animals and humans [13]. Recent studies evidence that *Hyalomma dromedarii* is the dominant tick species infesting dairy animals of selected study sites. Consequently using synthetic pyrethroids as acaricides in the fight against ticks causes acaricide resistance. Resistance development in tick populations is a significant consequence of using synthetic insecticides and is the principal threat to the efficacy of cypermethrin against the target vectors. The rationale of the present investigation was to carry out to study the comparative efficacy of DM, Cym, and α-Cym on *Hyalomma dromedarii* under laboratory conditions.

All the synthetic pyrethroids (5% Deltamethrin, 10% Cypermethrin, 6% α-Cypermethrin, were found to be effective against ticks. The best effective concentration was found to be 150 ppm after 48 h of post-treatment when compared with 24 h. The mortality rate was increased after 48 h of post-treatment of synthetic pyrethroids when compared with 24 h **(Figures 2 and 3)**. A dose-dependent increase in the rate of mortality was observed. Graphs were plotted with acaricides log concentrations and probit toxicity for calculation of LC_{50} **(Figures 2-4)**. The minimal lethal concentrations (MLC) that cause 95% acaricidal effects was 150 ppm after 48 h post-treatment when compared with Cym **(Table 2)**. The LC_{50} values 24 h post-treatment with DM, Cym and α-Cym were 66.93, 129.72, and 81.08 ppm respectively, whereas that 48 h post-treatment were 4.23, 37.25, and 3.12 ppm **(Table 2)**. Cym was found to be the least effective against the DM and α-Cym.

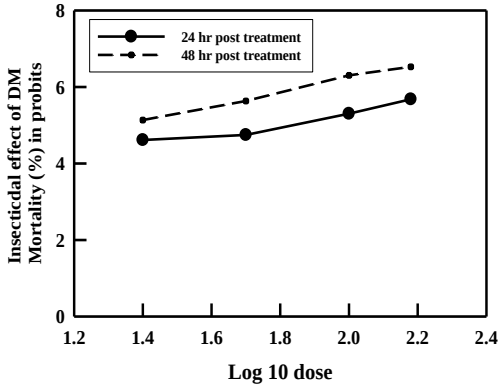

Figure 2. Insecticidal efficacy of DM after 24 and 48h of post-treatment on mortality

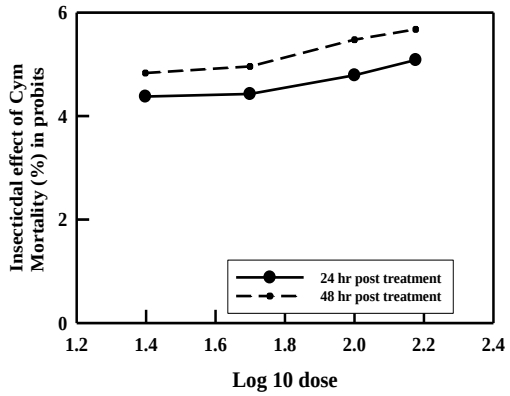

Figure 3. Insecticidal efficacy of Cym after 24 and 48h of post-treatment on mortality

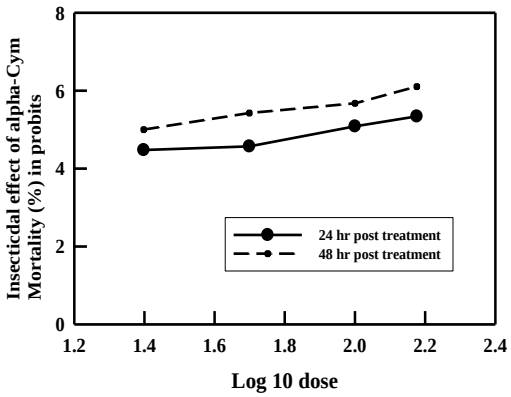

Figure 4. Insecticidal efficacy of α-Cym after 24 and 48h of post- on mortality

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	χ^2
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, we have focused on the species *H. dromedarii* because of its accessibility. Farmers of these chosen study areas have been reported recurrent applications of locally available acaricides DM and Cym without maintaining an optimal dose for the management of ticks mainly due to less effectiveness of most of the marketed products.

Our results are well consistent with other studies where it has been found that DM was more effective against ticks and showed 70 % mortality at the dose (25 ppm) when compared with Cym [14]. Further, Batiste Alentron *et al.* [15] have reported that the Cym was more toxic than fenvalerate on the larval and adult stage of *Drosophila melanogaster*; Age and condition of ticks before are pivotal as to the variability of results [16], these factors were standardized in standard laboratory conditions, and consistent results were obtained. The stock solutions of the insecticides were freshly prepared by suspending in 100% methanol, and the working concentrations were prepared using double distilled water (DDH_2O). The use of a suitable organic solvent is important in the formulation of the various dilutions as it facilitates absorption of the active compounds onto the surface of the target of biological materials and also promotes the penetration of active ingredients of the acaricide across the insect exoskeleton [12].

In AIT, LC_{50} values were calculated with toxicity data because this was the earliest parameter and the chances of data variation were low as the numbers of ticks used were high. In previous studies, the absence of repetition in AIT values has been attributed to significant data variation in minimal sample sizes [16]. Tick populations have an immense potential for resistance development because of their behavioral characteristics, and also resistance to different active compounds has been reported worldwide where ticks occur [17]. Sajid *et al.* [18] studied

that the pour-on formulations of Cym had higher *in vivo* efficacy on *Hyalomma anatolicum*.

To the best of our knowledge, our investigation is the first report on the distribution and abundance of ticks in the Tabuk, Hail, and Taif cities, Saudi Arabia. This country is arid and characterized by low annual rainfall. 95% species was *Hyalomma dromedarii*. Overall, this research provides the baseline information on ticks, which may be helpful to boost efficiency and safer control programs for them in arid countries worldwide. Observations on the efficacy of acaricides against adult male ticks revealed 100 % mortality at concentrations of 150 above. Below this dose, none of the groups showed complete mortality against ticks. All the adult ticks of the control group were alive even after 48 hours of treatment.

CONCLUSION

In this research, we compared the commercial formulations of DM, Cym, and α-Cym in vitro using AIT for their acaricidal properties on *Hyalomma dromedarii*. Our results showed that the percentage of ticks mortality was varied in all commercial formulations of selected insecticides. Hence, there is an urgent need to revise the doses of synthetic insecticides are used by livestock keepers and farmers. Alternatively, various effective control approaches have to be established in the due course of time

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CONFLICT OF INTEREST: None

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ETHICS STATEMENT: None

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