Toxic Effect of Pyrethroids on the Taiga Tick *Ixodes persulcatus* Schulze: Relationships between Dose and Knockdown Time

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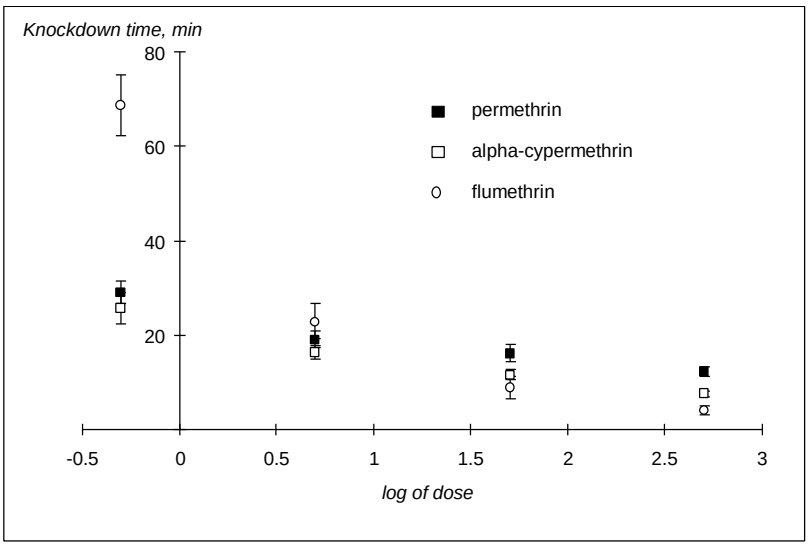
Some pyrethroids are widely used as clothing treatment for personal protection against ticks. The use of pyrethroids as protection agents is based on the knockdown effect, locomotor activity disorders and paralysis developing in a short time after the contact with the toxicant. So knockdown time is one of the critical characteristics of reliability of a pyrethroid as agent for personal protection. In spite of this, nothing is known how knockdown time depends on dose when a pyrethroid is used against ticks.

The present study is aimed to establish relationships between dose and knockdown time for certain widespread pyrethroids (permethrin, α-cypermethrin, and flumethrin) which are used (or could be used) for protection against taiga ticks *Ixodes persulcatus* Schulze. We applied topically 0.5 µL of an acetone solution of the compounds on the back side of unfed female ticks from natural population. After that we placed the tick on cotton fabric ribbon (10 x 70 cm) fixed at 70° angle to horizontal. The knockdown time was estimated as the period of time from the moment of toxicant application to the moment when the tick cannot hold onto the fabric and fall. The doses tested were 0.5, 5, 50, and 500 µg/g; each experiment was repeated in 30 replicates.

For all three pyrethroids the knockdown time varied within a wide range at every dose used. We observed similar unimodal distributions of the knockdown time in all experiments. The knockdown time reduces when the dose is incresed, and this relationship was non-linear for all the compounds tested as one can see from the figure. The relations for permethrin and α -cypermethrin approximated by similar log equations ($Y = 26.2 - 2.4\ln X$; $R^2 = 0.92$ and $Y = 22.4 - 2.6\ln X$; $R^2 = 0.96$, respectively, where X is knockdown time and Y is log-transformed dose). Contrary, the best approximation for flumethrin was hyperbolic equation $Y = 3.9 + 121.8/X$ ($R^2 = 0.99$).



Mean Knockdown Times for Taiga Ticks at Various Doses of Pyrethroids.
(Error of mean is indicated by error bars).

Flumethrin at high doses caused knockdown developing in the shortest time, although its knockdown time was longest at lower doses. In contrast, knockdown time of pemethrin and alphacypermethrin was less dependent on dosage.

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