Effets neurotoxiques de concentrations sublétales d'anatoxine a(s)
Neurotoxic effects of sublethal concentrations of cyanobacterial extract containing anatoxin-a(s) on Nauphoeta cinerea cockroaches

Abstract

The detection of cyanotoxins, such as the anatoxin-a(s), is essential to ensure the biological safety of water environments. Here, we propose the use of Nauphoeta cinerea cockroaches as an alternative biological model for the biomonitoring of the activity of anatoxin-a(s) in aquatic systems. In order to validate our proposed model, we compared the effects of a cyanobacterial extract containing anatoxin-a(s) (CECA) with those of the organophosphate trichlorfon (Tn) on biochemical and physiological parameters of the nervous system of Nauphoeta cinerea cockroaches. In brain homogenates from cockroaches, CECA (5 and 50g/g) inhibited acetylcholinesterase (AChE) activity by 53±2% and 51±7%, respectively, while Tn (5 and 50g/g) inhibited AChE activity by 35±4% and 80±9%, respectively (p<0.05; n=6). Moreover, CECA at concentrations of 5, 25, and 50µg/g decreased the locomotor activity of the cockroaches, diminishing the distance travelled and increasing the frequency and duration of immobile episodes similarly to Tn (0.3g/g) (p<0.05, n=40, respectively). CECA (5, 25 and 50g/g) induced an increase in the leg grooming behavior, but not in the movement of antennae, similarly to the effect of Tn (0.3g/g). In addition, both CECA (50µg/200l) and Tn (0.3µg/200l) induced a negative chronotropism in the insect heart (37±1 and 47±8 beats/min in 30min, respectively) (n=9, p>0.05). Finally, CECA (50µg/g), Tn (0.3µg/g) and neostigmine (50µg/g) caused significant neuromuscular failure, as indicated by the monitoring of the in vivo neuromuscular function of the cockroaches, during 100min (n=6, p<0.05, respectively). In conclusion, sublethal doses of CECA provoked entomotoxicity. The Tn-like effects of CECA on
Nauphoeta cinerea cockroaches encompass both the central and peripheral nervous systems in our insect model. The inhibitory activity of CECA on AChE boosts a cascade of signaling events involving octopaminergic/dopaminergic neurotransmission. Therefore, this study indicates that this insect model could potentially be used as a powerful, practical, and inexpensive tool to understand the impacts of eutrophication and for orientating decontamination processes.

**Keywords**

Anatoxin-a(s); Anticholinesterase activity; Central nervous system neurotoxicity; Neuromuscular blockade; Organophosphate compounds; Trichlorfon.

#anatoxin-a(s) #neurotoxin #neurotoxicity

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