ACUTE TOXIC EFFECTS OF DELTAMETHRIN ON RED SWAMP CRAYFISH, *PROCAMBARUS CLARKII* (DECAPODA, CAMBARIDAE)  

BY  

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ABSTRACT  

In order to know the acute toxic effects of the synthetic pyrethroid deltamethrin on red swamp crayfish, *Procambarus clarkii*, an acute toxicity test was carried out. The results showed that the 24, 48 and 96 h LC₅₀ values were 0.156, 0.099 and 0.056 μg/l, respectively. The abnormal behavioural responses and toxic signs can be described as typical neurotoxic symptoms, characterized by ataxia, hyperexcitation, convulsion, and paralysis. The residue of deltamethrin in haemolymph, gill, muscle, and liver of the crayfish was under the limit of quantification of the GC-MS method after a 96-h exposure to 0.05 μg/l deltamethrin and a 24-h exposure to 0.1 μg/l deltamethrin. Besides that, the sublethal effects caused by deltamethrin were assessed by using cytochrome c oxidase (CCO) activity, lactate dehydrogenase (LDH) activity, and lactic acid levels as sensitive biomarkers. Results showed that 24 h exposure to 0.1 μg/l deltamethrin significantly inhibited the CCO activity (*P* < 0.05), but increased LDH activity (*P* < 0.05) and the lactic acid level (*P* < 0.05) in gills, which further indicated that the aerobic metabolism was inhibited by deltamethrin in the gill while the anaerobic metabolism was stimulated.

RÉSUMÉ  

Afin de connaître les effets toxiques aigus de la deltaméthrine pyréréthrine sur l’écrevisse de Louisiane *Procambarus clarkii*, un test de toxicité aigue a été effectué. Les résultats montrent que les valeurs de la LC₅₀ à 24, 48 et 96 h ont été respectivement de 0.156, 0.099 et 0.056 μg/l. Les réponses comportementales anormales et les signes toxiques peuvent être décrits comme des symptômes neurotoxiques typiques, caractérisés par de l’ataxie, hyperexcitation, convulsion et paralysie. Les traces de deltaméthrine dans l’hémolymphe, les branchies, les muscles et l’hépatopancréas de
l’écrevisse étaient en dessous des limites de quantification par la méthode GC-MS après 96 h d’exposition à 0,05 μg/l et à 24 h d’exposition à 0,1 μg/l de deltaméthrine. Par ailleurs les effets sublethaux causés par la deltaméthrine ont été évalués en utilisant l’activité de la cytochrome oxydase c (CCO), de la lactate déshydrogénase (LDH) et les niveaux d’acide lactique comme bio marqueurs sensibles. Les résultats montrent que 24 h d’exposition à 0,1 μg/l de deltaméthrine inhibent significativement l’activité de CCO ($P < 0.05$), mais augmentent l’activité de LDH ($P < 0.05$), le niveau d’acide lactique ($P < 0.05$) dans les branchies, ce qui suggère que le métabolisme aérobie a été inhibé par la deltaméthrine dans les branchies alors que le métabolisme anaérobie a été stimulé.

**INTRODUCTION**

In China, the red swamp crayfish, *Procambarus clarkii* (Girard, 1852) was first found in the city of Nanjing, Jiangsu province in the 1930s, and then it quickly spread and dominated the local aquatic ecosystems. However, the Chinese have developed a taste for the crayfish, which then became an important aquaculture species. In 2005, the production of *Procambarus clarkii* in Jiangsu province reached 6000 tonnes, which accounted for nearly 90% of the total crayfish export volume in China.

In the southern U.S.A., Portugal and China, rice planting and crayfish culturing are often integrated as crayfish and rice integrated system of production (CRISP) (Anastácio et al., 1999; Barbee et al., 2010). Although the integrated production mode can greatly enhance the overall income, the production practices used in one crop often affect the other. Especially the pesticides used to control rice pests can be highly toxic to the non-target crayfish (Sucahyo et al., 2008).

Pyrethroids are synthetic analogues of the pyrethrins, extracted from the flowers of *Chysanthemum cinerariaefolium* (Trevir.) Vis., commonly used as pesticides in rice field in China and other countries. They have been employed as substitutes for organochlorines, organophosphates and carbamate insecticides because of their low persistence in the environment and comparatively lower mammalian toxicity (Pimpão et al., 2007; Velisek et al., 2007). It is shown that pyrethroids are neurotoxic pesticides and extremely toxic to fish at concentrations 1000 times lower than the corresponding values for birds and other animals (Köprücü & Aydin, 2004).

Deltamethrin, a synthetic type-II pyrethroid insecticide, is a widely used pesticide in the rice field, even though it is already known to be highly toxic to the non-target aquatic organisms (Ratushnyak et al., 2005; Cengiz, 2006; Cengiz & Unlu, 2006; El-Sayed et al., 2007). However, there are few data concerning its acute toxicity in red swamp crayfish, though it has been argued that the red swamp crayfish expresses high sensitivity to pyrethroids (Morolli et al., 2006).