

微囊藻毒素与阿特拉津复合染毒对鲤鱼的组织病理学效应

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Histopathological Effects of Combined Pollution of Microcystin and Atrazine on *Cyprinus carpio*

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摘要

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摘要 以中国淡水环境中常见的鲤鱼 (*Cyprinus carpio*) 为对象, 考察了微囊藻毒素MC-LR与阿特拉津单一和复合染毒对鲤鱼的生态毒理效应。结果表明, 较低浓度的两种非基线毒物MC-LR和阿特拉津共同作用能引起鲤鱼肝脏和鳃组织产生明显的病理学变化。1 $\mu\text{g}\cdot\text{L}^{-1}$ MC-LR和5 $\mu\text{g}\cdot\text{L}^{-1}$ 阿特拉津复合染毒使肝组织中央静脉血管内皮破裂, 胰腺泡破裂, 出现显著的溶血现象, 肝细胞空泡化变性更明显, 细胞核高度浓缩; 鳃组织电镜扫描照片显示, 复合染毒使鲤鱼鳃组织多个部位病理学变化更为严重, 尤其是鳃小片排列更加疏松且凌乱, 上皮细胞边界更加模糊, 细胞破损严重; 此外, 5 $\mu\text{g}\cdot\text{L}^{-1}$ MC-LR和5 $\mu\text{g}\cdot\text{L}^{-1}$ 阿特拉津共同作用还可诱导鲤鱼肝细胞产生显著的细胞凋亡。该研究阐明了水环境中低浓度污染物共存对鱼类的潜在风险, 可为环境污染物安全阈值的确定和污染物水生态风险评价的完善提供科学依据。

关键词: 微囊藻毒素 阿特拉津 鲤鱼 组织病理学 细胞凋亡

Abstract: *Cyprinus carpio*, a common species of fish in Chinese freshwaters, was selected as subject in the study on ecotoxicological effects of MC-LR, atrazine, and their combination on the fish. Results show that the coexistence of MC-LR and atrazine, two non-base toxicants, at relatively low concentration could induce significant histopathological alterations in the livers and gills. The mixture of 1 $\mu\text{g}\cdot\text{L}^{-1}$ MC-LR and 5 $\mu\text{g}\cdot\text{L}^{-1}$ atrazine would cause to the fish histopathological damages, such as ruptured epithelium of the central retinal vein, acini pancreas, hemolysis, hepatocyte vacuolation, pyknosis, etc. in liver of the fish. The symptoms were more apparent and serious than those in the fish exposed to single MC-LR or atrazine. Electron microscopic scanning of the gill tissues show that the histopathological damages induced to the gill by MC-LR combined with atrazine were more severe: especially the gill lamellae array became loose and messy, boundary of the epithelial cells blurred and the cells severely broken. Furthermore, the combined exposure to 5 $\mu\text{g}\cdot\text{L}^{-1}$ MC-LR and 5 $\mu\text{g}\cdot\text{L}^{-1}$ atrazine could induce a significant hepatic apoptosis of *C. carpio*. The findings indicate potential risks of the coexistence of different pollutants, even at low concentration, in the water environment to aquatic organisms, and provide valuable references for determination of safety threshold of pollutants and perfection of aquatic ecological risk assessment of pollutants.

Keywords: microcystin atrazine *Cyprinus carpio* histopathology apoptosis

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