THE UNIVERSITY OF HONG KONG
SCHOOL OF BIOLOGICAL SCIENCES

Postgraduate Student Public Seminar

"A COMPREHENSIVE ECOLOGICAL RISK ASSESSMENT OF RETINOIC ACIDS IN URBANIZED COASTAL MARINE ENVIRONMENTS"

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Abstract

Being a class of vitamin A's main derivatives, retinoic acids (RAs), including all-*trans*-RA (at-RA), 9-*cis*-RA (9c-RA), 13-*cis*-RA (13c-RA), and their corresponding metabolites (i.e., 4-oxo-RAs: all-*trans*-4-oxo-RA, 9-*cis*-4-oxo-RA and 13-*cis*-4-oxo-RA) are crucial to animals' growth and development. They can be excreted through urination from humans and animals, and thus have been constantly detected in aquatic environments. This study aimed to evaluate the risk of RAs to marine environments through studying their environmental fate and toxic effects.

Sewage treatment plants (STPs) were identified as a main source of RAs and 4-oxo-RAs, as STPs only partially removed these chemicals. Total concentrations of these chemicals in influent, effluent and sludge from the six STPs in Hong Kong were between 21.5–33.1 ng/L, 12.0–20.4 ng/L, and 4.33–7.02 ng/g dry weight, respectively. The dominating target compounds in sewage were at-RA and 13c-RA.

Abnormal developments in aquatic species were observed at elevated concentrations of RAs and 4-oxo-RAs in previous study. In this study, toxicity tests were conducted on six marine species, including one microalga, four invertebrates and one fish, towards exposure to at-RA, the most abundant and widely distributed form of RA in marine environments. Among the six test species, embryos of the marine medaka *Oryzias melastigma* were the most sensitive to at-RA while the gastropod *Monodonta labio* was the least sensitive. An interim marine-specific predicted no-effect concentration of at-RA was derived at 2,300 ng/L.

Spatiotemporal variations of concentrations and compositions of RAs and 4-oxo-RAs in Hong Kong's seawaters and during algal blooms were determined. Waterborne concentrations of these compounds were found to be greater during algal blooms than that in absence of algal blooms. Average total concentrations of the studied compounds in seawater were up to 0.790 and 0.427 ng/L in dry and wet seasons, respectively, though no significant seasonal variation was observed. During algal blooms, the studied compounds were detected up to 4.74 ng/L. Although there was no immediate risk of these compounds to Hong Kong's marine environments regardless of the presence of algal blooms, a hazard quotient showed that their ecological risk during algal bloom incidents was 10-fold greater than the time without blooms.

Information on degradation and transformation of RAs in seawater is essential to assess the risk of RAs to aquatic organisms. Laboratory-based experiments were conducted to study the possible factors affecting the degradation and transformation of at-RA. Results indicated that more than 80% of at-RA was degraded in the first 48 hours regardless of the type of seawater (i.e., artificial seawater, unfiltered and filtered natural seawater; with or without autoclave treatment). In particular, over 90% of at-RA was degraded within 24 hours in non-autoclaved, unfiltered natural seawater where the presence of microorganisms and suspended organic matters could have jointly facilitated its degradation and removal from the water column.

With the newly generated information on the source, toxicity, distribution, fate and ecological risk of RAs, appropriate management decision could be devised to better monitor and manage the contamination of RAs and 4-oxo-RAs in densely populated coastal cities like Hong Kong.

--- ALL ARE WELCOME ---