ES S29

Preliminary Ecological Risk Assessment of Butylparaben and Benzylparaben —1. Removal Efficiency in Wastewater Treatment, Acute/Chronic Toxicity for Aquatic Organisms, and Effects on Medaka Gene Expression

Hiroshi Yamamoto*, Mikako Watanabe, Yoshiko Hirata, Yuki Nakamura, Yudai Nakamura, Chise Kitani, Jun Sekizawa, Masaya Uchida[1], Hiroshi Nakamura[1], Yoshihiro Kagami[1], Masaaki Koshio[2], Narisato Hirai[2] and Norihisa Tatarazako[2]

Department of Physical, Chemical, Geological and Environmental Sciences, Faculty of Integrated Arts and Sciences, The University of Tokushima, 1-1 Minamijosanjima-cho, Tokushima 770-8502, Japan
[1]Ecogenomics Inc., 1-1 Hyakunenkouen, Kurume, Fukuoka 839-0864, Japan
[2]National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba, Ibaraki 305-8506, Japan

(Received October 12, 2007; accepted December 25, 2007)

*E-mail: hiroshi@ias.tokushima-u.ac.jp

Key words: aquatic organisms, DNA microarray, medaka vitellogenin, preservatives, sewage treatment

Butylparaben and benzylparaben, used as preservatives mainly in cosmetic products, have recently been found to be weakly estrogenic. Batch activated-sludge treatment and batch chlorination were carried out to roughly determine the removal efficiency of a wastewater treatment plant. Combining the removal efficiency with the estimated annual consumption and the unaltered excretion ratio, the maximum predicted environmental concentration (PEC) was estimated. Conventional acute/chronic toxicity tests were conducted using Japanese medaka (*Oryzias latipes*), daphnia (*Daphnia magna*), and green algae (*Pseudokirchneriella subcapitata*) for *n*-butylparaben, *i*-butylparaben, and benzylparaben. Medaka vitellogenin assays were also conducted for the three compounds and DNA microarray analysis was carried out to examine the effects of benzylparaben on gene expression. The plasma vitellogenin concentration of male medaka increased for concentrations of 200, 100, and 100 μg L^{-1} *n*-butylparaben, *i*-butylparaben, and benzylparaben for 14 days, respectively, while the expression levels of genes encoding proteins such as p53, cytochrome P450 3A40, and choriogenin-L increased for concentrations higher than 4 μg L^{-1} of benzylparaben. Furthermore, the predicted no-effect concentration (PNEC) was calculated using the lethal or effect concentration 50 (LC_{50} or EC_{50}) values and no-effect concentrations (NOECs) obtained in the toxicity tests for these compounds. The maximum concentrations found in the aquatic environment or sewage effluent (MEC_{eff}) were used to carry out preliminary environmental risk assessment. The calculated MEC/PNEC ratio suggests the necessity of further study such as a more detailed large-scale monitoring and chronic toxicity tests including reproduction inhibition and endocrine disruption.