

Ecotoxicity Assessment of Fluoroquinolone Mixtures towards Algae (*Scenedesmus Vacuolatus*) and Duckweed (*Lemna Minor*)

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Extended Abstract

The extensive usage of antimicrobial drugs in human and veterinary medicine worldwide emphasizes the need to increase the state of knowledge concerning their impact on the stability of the environment (Kemper 2008; Sarmah et al., 2006). For this purpose three pharmaceuticals from the group of fluoroquinolones were selected: enrofloxacin, ciprofloxacin and norfloxacin. These compounds are antimicrobial agents effective in treating a broad-spectrum of Gram-positive and Gram-negative bacteria, frequently used towards livestock and in aquaculture. These drugs act by inhibiting two enzymes involved in bacterial DNA synthesis (gyrase and topoisomerase IV), both of which are essential for bacterial DNA replication. As a result normal bacterial DNA synthesis is interrupted, causing cell death (Blondeau 2004).

Available data on the environmental fate of the selected fluoroquinolones indicate that these substances are subject to strong sorption onto soil, sediment and organic matter. These drugs exhibit relatively high persistence, being resistant to biodegradation, hydrolysis and increased temperatures. Although they are susceptible to photolytic decomposition, they remain stable within aquatic environment for up to several weeks, as photodecomposition declines with increasing water depth and turbidity. Also is worth mentioning that since these substances are detected in surface waters, their actual presence in the environment may be substantially underestimated (Kümmerer 2009; Córdova-Kreylos & Scow 2007).

A number of studies have been published investigating the aquatic toxicity of some of the selected compounds (mostly for ciprofloxacin and enrofloxacin) – however one can notice a shortage in research involving instrumental analysis related to the ecotoxicological tests – which implies possible error concerning the quantitative and qualitative composition of the experimental samples. Furthermore most of the studies in literature assess the toxicological effects of individual substances, where in natural media those are not present as a single drug, hence the need for the evaluation of mixture effects.

Therefore, the aim of this study was to evaluate the mixture toxicity of selected fluoroquinolones towards algae (*Scenedesmus vacuolatus*) and duckweed (*Lemna minor*). The selected ecotoxicity tests were carried out basing on internationally accepted guidelines and published research. The experiment with duckweed (*L. minor*) was performed in accordance with OECD Guideline 221, which accurately describe the course of a sub-chronic seven days' growth inhibition test. Whereas the acute growth inhibition test with green algae (*S. vacuolatus*) was a modified version described by Altenburger et al. (1990) of the standardized test (ISO 8692). Additionally all tests were combined with chemical analysis

(HPLC) in order to investigate the actual exposure concentration and the stability of the compounds used in the experiment.

Data for single compounds as well as mixtures of all three pharmaceuticals was interpreted according to structure-activity relationships with the aid of statistical methods (using R software) and compared with predictions based on the concentration addition (CA) model. The results show that fluoroquinolones act broadly in accordance with the CA in the case of both testes organisms.

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