

Toxicity and Biodegradability of Veterinary Antibiotic Tiamulin

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Abstract : Antibiotics are extensively used in human medicine and also in animal husbandry to prevent or control infections. Recently, a lot of attention has been put on veterinary antibiotics, because their global consumption is increasing and it is expected to be 106.600 tons in 2030. Most of veterinary antibiotics are introduced into the environment via animal manure, which is used as fertilizer. One of such veterinary antibiotics is tiamulin. It is used the form of fumarate for treatment of pig and poultry. It is used against prophylaxis of dysentery, pneumonia and mycoplasmal infections, but its environmental impact is practically unknown. Tiamulin has been found very persistent in animal manure and thus it is expected that can be, during rainfalls, transported into the aquatic environment and affect various organisms. For assessment of its environmental impact, it is necessary to evaluate its biodegradability and toxicity to various organisms from different levels of a food chain. Therefore, the aim of our study was to evaluate ready biodegradability and toxicity of tiamulin fumarate to various organisms. Bioassay used included luminescent bacterium *Vibrio fischeri* heterotrophic and nitrifying microorganisms of activated sludge, water flea *Daphnia magna* and duckweed *Lemna minor*. For each species, EC_{50} values were calculated. Biodegradability test was used for determination of ready biodegradability and it provides information about biodegradability of tiamulin under the most common environmental conditions. Results of our study showed that tiamulin differently affects selected organisms. The most sensitive organisms were water fleas with $48hEC_{50} = 14.2 \pm 4.8$ mg/L and duckweed with $168hEC_{50} = 22.6 \pm 0.8$ mg/L. Higher concentrations of tiamulin (from 10 mg/L) significantly affected photosynthetic pigments content in duckweed and concentrations above 80 mg/L cause visible chlorosis. It is in agreement with previous studies showing significant effect of tiamulin on green algae and cyanobacteria. Tiamuline has a low effect on microorganisms. The lower toxicity was observed for heterotrophic microorganisms ($30minEC_{50} = 1656 \pm 296$ mg/L), than *Vibrio fisheri* ($30minEC_{50} = 492 \pm 21$) and the most sensitive organisms were nitrifying microorganisms ($30minEC_{50} = 183 \pm 127$ mg/L). The reason is most probably the mode of action of tiamulin being effective to gram-positive bacteria while gram-negative (e.g., *Vibrio fisheri*) are more tolerant to tiamulin. Biodegradation of tiamulin was very slow with a long lag-phase being 20 days. The maximal degradation reached 40 ± 2 % in 43 days of the test and tiamulin as other antibiotics (e.g. ciprofloxacin) are not easily biodegradable. Tiamulin is widely used antibiotic in veterinary medicine and thus present in the environment. According to our results, tiamulin can have negative effect on water fleas and duckweeds, but the concentrations are several magnitudes higher than that found in any environmental compartment. Tiamulin is low toxic to tested microorganisms, but it is very low biodegradable and thus possibly persistent in the environment.

Keywords : antibiotics, biodegradability, tiamulin, toxicity

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