Effect of advanced oxidation process on pesticide removal and toxicity

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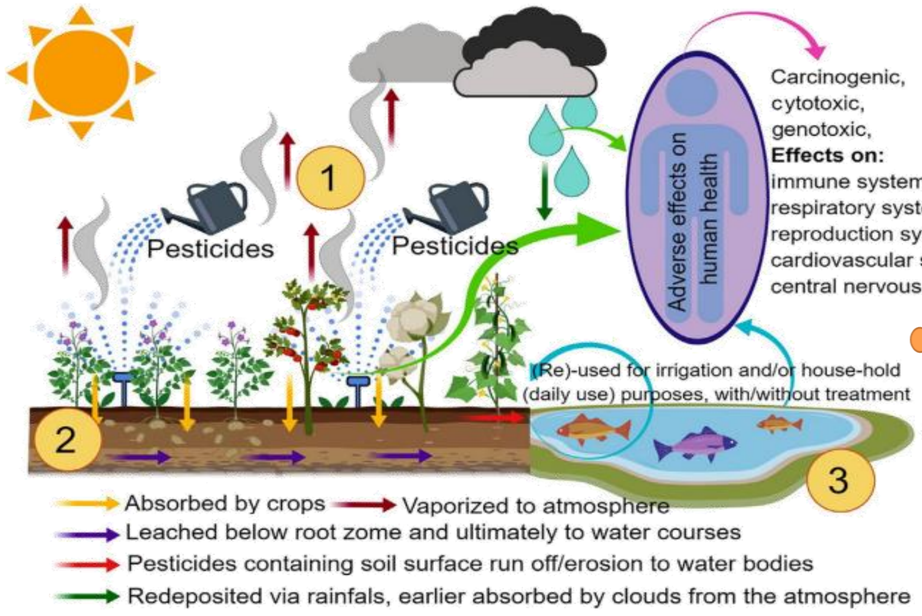
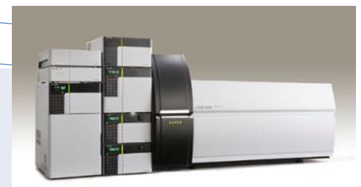


From Chavoshani, A., Hashemi, M., Mehdi Amin, M., & Ameta, S. C. *Risks and challenges of pesticides in aquatic environments. Micropollutants and Challenges* (2020) *179–213.*

The widespread use of pesticides in modern agricultural practices has resulted in the pollution of various environmental matrices, including air, soil and water. Consequently, contaminated environmental matrices adversely affect human health and non-target animals in several ways. For these reasons, there is a strong need for effective control and removal of pesticides from the environment. Photolysis in the presence of hydrogen peroxide (H_2O_2) is used as an advanced oxidation method for removing organic pollutants from water. Solar radiation is a permanent source of natural energy that, together with other forms of renewable energy, offers great potential for widespread application as it is abundant and available. However, although this method effectively reduces the concentrations of many pollutants, it can also lead to the formation of toxic degradation or transformation products. The aim of this work is to determine the effect of H_2O_2 on the removal of the pesticides acetamiprid and thiacloprid in the presence of simulated solar radiation by chromatographic method, to optimize the process and to determine the effects of the process on ecotoxicity.



Application of simulated solar radiation with the presence of H_2O_2 and determination of optimal conditions

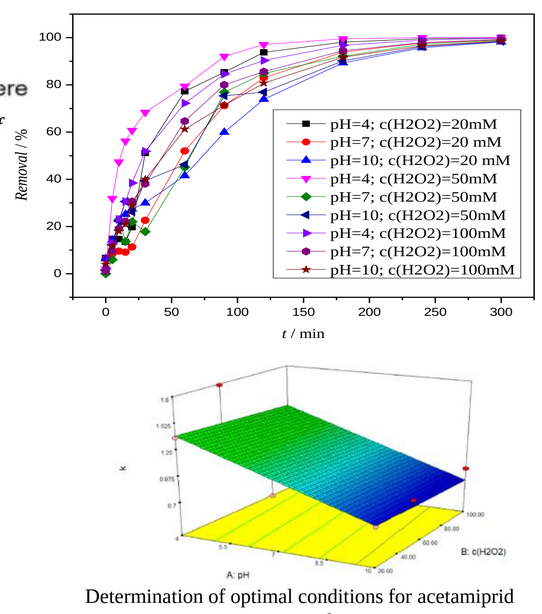
Identification of transformation/degradation products with HPLC-QqQ (LCMS-8050, Shimadzu)

Suntest CPS+ device (Atlas, Linsengericht, Germany)

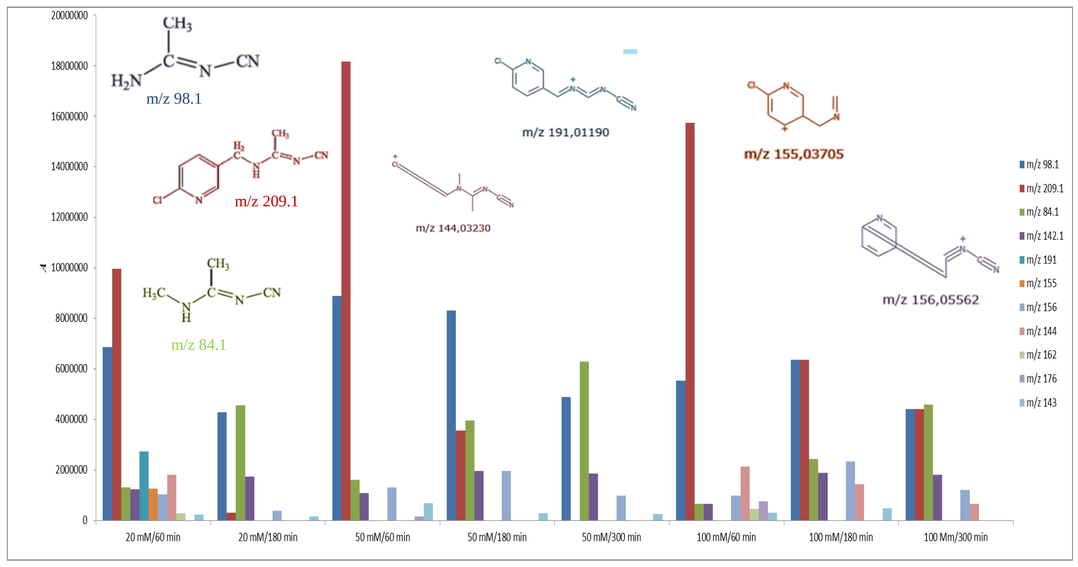
Determination of toxicity with the bacterium *Vibrio fischeri*

LUMIStox 300 Hach Lange instrument (Berlin, Germany)

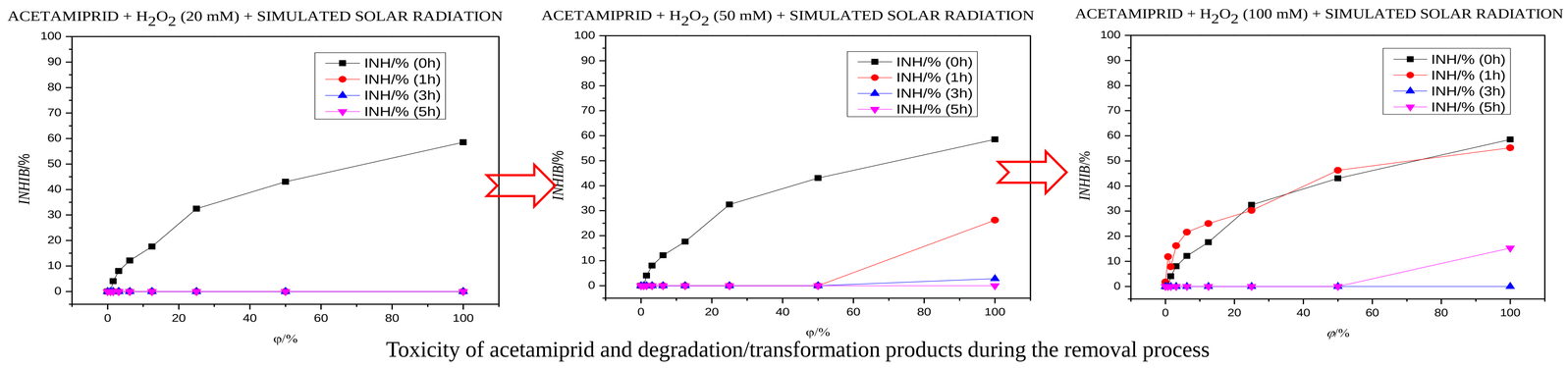
Assessment of toxicity and monitoring of the formation of toxic products in order to reduce potential negative impacts on the environment and human health



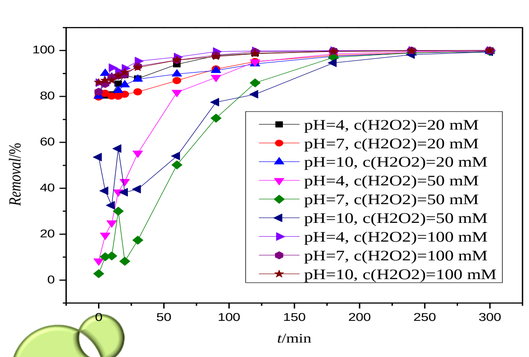
Determination of optimal conditions for acetamiprid removal

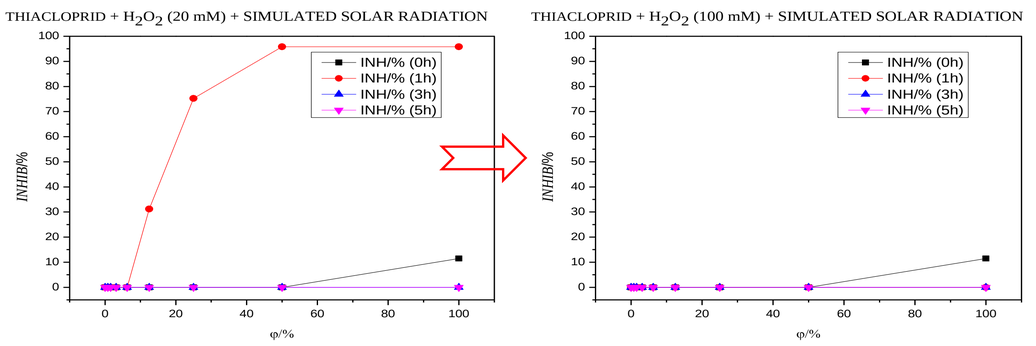


The presence of degradation/transformation products



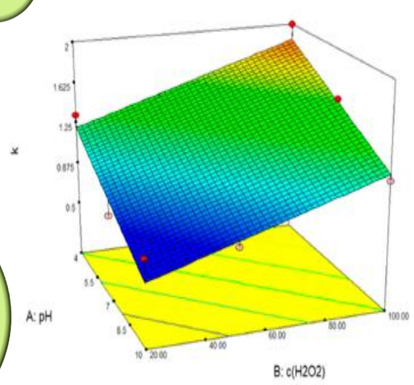
Toxicity of acetamiprid and degradation/transformation products during the removal process



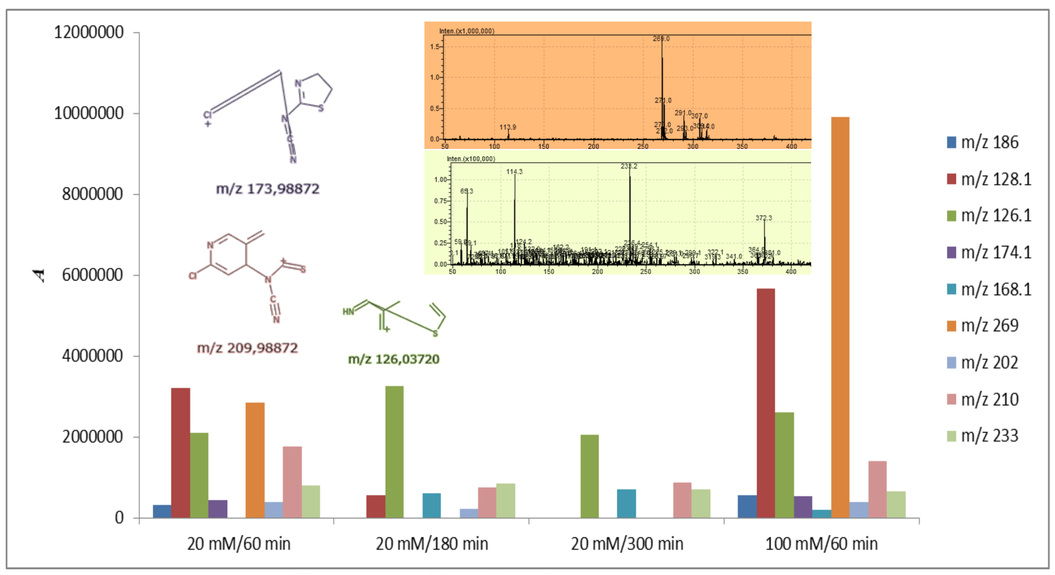


Toxicity of thiacloprid and degradation/transformation products during the removal process

- Acetamiprid is a pesticide whose removal depends solely on the pH-value.
- The removal of thiacloprid is influenced by the pH-value of the solution and the concentration of hydrogen peroxide.
- Neonicotinoids showed the following removal trend: thiacloprid (99.39 to 100%) > acetamiprid (97.39 to 99.56%).
- Removal has been shown to be more effective in acidic solutions than in alkaline or neutral solutions.
- A pH-value of 4 proved to be optimal and a H_2O_2 concentration of 20 mM.
- The LC-MS/MS method proved to be excellent for the detection and identification of known and new unknown products, i.e. degradation and transformation compounds of neonicotinoids.
- The formation of three photolytic products known in the literature (acetamiprid-*N*-desmethyl, *N*′-cyano-*N*-methyl acetamidine and *N*′-cyanoacetamidine) was confirmed for acetamiprid.
- Acetamiprid samples in which a higher proportion of the newly formed *m/z* 209.1 product was observed showed higher toxicity.
- After 5 h, at 20 mM H_2O_2, inhibition is completely reduced



Determination of optimal conditions for the removal of thiacloprid



The presence of degradation/transformation products

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