International Research Journal of Pharmacy and Pharmacology
ISSN 2251-0176
2020
Vol.8 No.4

Artificial neural network modeling of the elimination of antibiotics in the wastewater by advanced processes of oxidation

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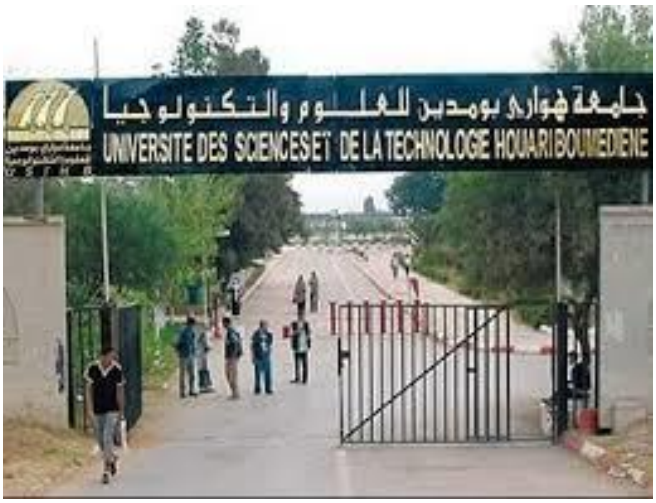
Abstract

In recent years, different pharmaceutical compounds have sullied the aqueous environment, counting antibiotics which required uncommon consideration due to their supported use in human and veterinary pharmaceutical. Such products are actually non-biodegradable. Antibiotics are the biggest concern of all pharmaceutical products, as their environmental contamination can increase aquatic toxicity. Furthermore, the presence of these compounds in water resources even at very low concentrations improves the bacterial resistance against them, which create a new types of microorganism antibiotic assistance named superbugs. Antibiotic resistance is the ability of a bacterium or other micro-organisms to survive and reproduce in the presence of antibiotic doses previously thought to have been successful against it. Antibiotic are widely used not only in the treatment and prevention of diseases in human and veterinary medicine, but also in the improvement of feed quality and growth rates in the livestock and poultry industries. Analytical study of observational data to determine trends in antibiotic consumption in 76 countries from 2010-2015 found that over the 15-year period studied global antibiotic consumption had increased by 65%. Antibiotic usage increased from the 21.1 billion defined daily doses to 34.8 billion. The antibiotic consumption rate increased by 39 % from 11.3 to 15.7 defined daily doses per 1,000 inhabitants per day.

A typical example for antibiotics is Cefixime which is a broad-spectrum, third-generation cephalosporin antibiotic derived semi synthetically from the marine fungus Cephalosporium acremonium with antibacterial activity. Cefixime is (6R,7R)-7-[[(2Z)-2-(2-amino-1,3-thiazol-4-yl)-2-(carboxymethoxyimino)acetyl]amino]-3-ethenyl-8-oxo-5-thia-1-azabicyclo[4.2.0]oct-2-ene-2-carboxylic acid with molecular formula C16H15N5O7S2.

Because of antibacterial existence, conventional biological approaches cannot effectively eliminate antibiotic residues or polluted waters. On the other hand, advanced processes of oxidation (AOPs) have proved to be an appropriate alternative for the rapid degradation of recalcitrant and non-biodegradable compounds in water. In particular, photocatalysis has been used successfully to degrade various types of pharmaceutical drugs and organic compounds.

Furthermore, An artificial neural network model has been proposed for the prediction of photocatalysis Cefixime efficiency. The network was trained using the experimental data obtained at different pH with different catalyst dose and initial CFX concentration. In order to find the most suitable and secure network, various algorithms and transfer functions for hidden layer have been tested. By trial and error procedure, the optimum number of neurons in the hidden layer was found. The predicted data from the designed ANN model were found to be in a good agreement with the experimental data (R2 = 0.996).



Biography:

BAALOUDJ Oussama is a second year PhD student and a part-time faculty member in the Faculty of Mechanical Engineering and Process Engineering at Houari Boumédiène University of Science and Technology. his doctoral research investigates the elimination of antibiotics in the wastewater by advanced processes of oxidation and Artificial neural network modeling. He takes a multidisciplinary approach that encompasses the fields of Modilling, photocatalysis and pharmaceutical process.

He is founder of a mobile application that facilitate the exchange of medicines in Algeria named as Pharma Exchange.

He has 8 months of experience as a research and development engineer (R&D) in a pharmaceutical company called Pharmalliance. He holds a master's and degree in pharmaceutical process engineering from Constantine National Polytechnic University, Algeria, which studied the formulation of a detergent solution for dental scaling. Also the study of fermentation in bioethanol in the presence of saccharomyces cerevisiae. His training and technical skills are both theoretical and practical with many pharmaceutical research & development projects.

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30th Annual European Pharma Congress; Berlin, Germany- May 18-19, 2020

Abstract Citation:

Oussama BAALOUDJa, Artificial neural network modeling of the elimination of antibiotics in the wastewater by advanced processes of oxidation, Pharma Europe 2020, 30th Annual European Pharma Congress; Berlin, Germany- May 18-19, 2020
(https://europe.pharmaceuticalconferences.com/abstract/2020/artificial-neural-network-modeling-of-the-elimination-of-antibiotics-in-the-wastewater-by-advanced-processes-of-oxidation)