Pharmaceutical Active Compounds in Surface Waters of Latin America: environmental risk conditions at the beginning of the third decade of the 21st century

Emerging Pollutants in Aquatic Ecosystems

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INTRODUCTION

Pharmaceutical active compounds (PhACs) are contaminants of emerging interest due to their potential adverse impacts on ecosystems and human health and the absence of monitoring and regulatory frameworks to protect the environment from their emissions.

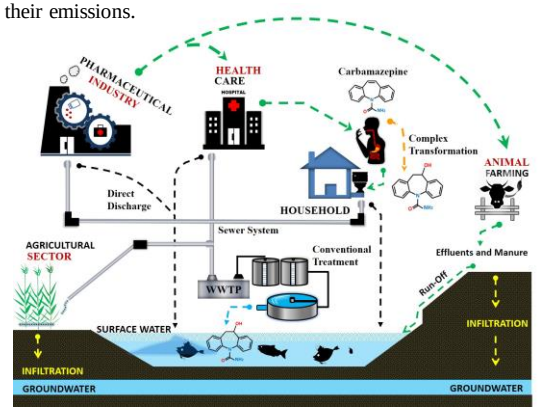


Fig. 1 Main input sources of PhACs into the environment.

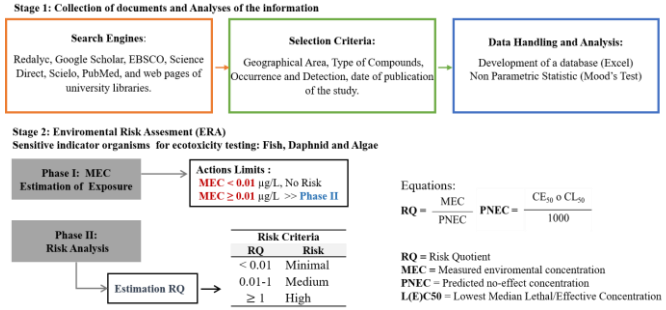
PhACs usually reach the surface water (SW) compartment though the release, runoff and/or infiltration of treated (TWW) and untreated wastewater (WW), following the paths shown in Fig. 1.

Objective

The purpose of this work is to revise the occurrence, concentrations and sources of Pharmaceutical Active Compounds (PhACs) and ethinylestradiol (EE2) in the surface water compartment of Latin America (LATAM) and stablish the environmental risk conditions at the beginning of the third decade of the 21st century

METHODOLOGY

A total of 79 published studies in English, Portuguese and Spanish were considered for this review.



RESULTS

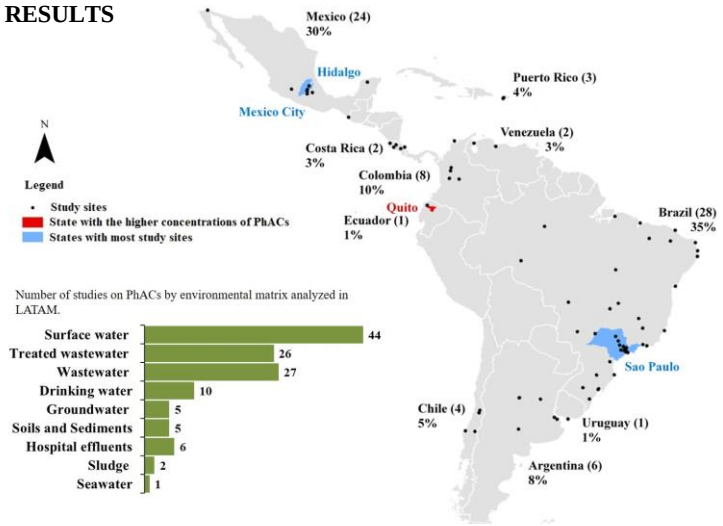


Fig. 2 Studies on the occurrence of PhACs in environmental matrices in LATAM and their geographical distribution.

Only ten of the LATAM countries produced data on PhAC (Fig. 2), among which TWW and WW were the most analyzed compartments, while SW accounted for 56% of research efforts. Given the reported concentrations, three states in Brazil (Sao Paulo), Mexico (Hidalgo) and Ecuador (Quito) represented the greatest environmental concern.

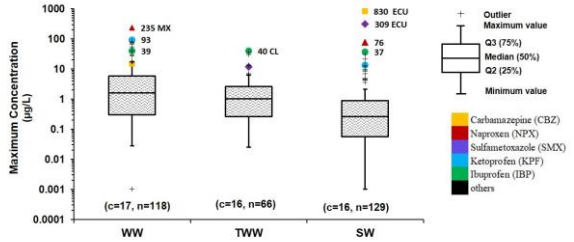


Fig. 3 Box plots of maximum concentrations (worst scenario) of PhACs in WW, TWW, and SW in LATAM. c – number of compounds; n – sample size.

The Box Plots relate the maximum concentrations of PhACs in SW with those of the two matrices that were often reported impacting the SW quality, TWW and raw WW. The Moods' median test (p value = 0.088) reveals no significant difference between WW and TWW. Outstanding maximum concentrations of 830 µg/L of carbamazepine (CBZ) and 309 µg/L of sulfametoxazole (SMX) were reported at a given time in SW from Ecuador, as well as many other outlier values elsewhere. Even though concentration of EE2 found in Brazil (6.8 µg/L) plot within the average values, they are high enough to cause significant environmental concern.

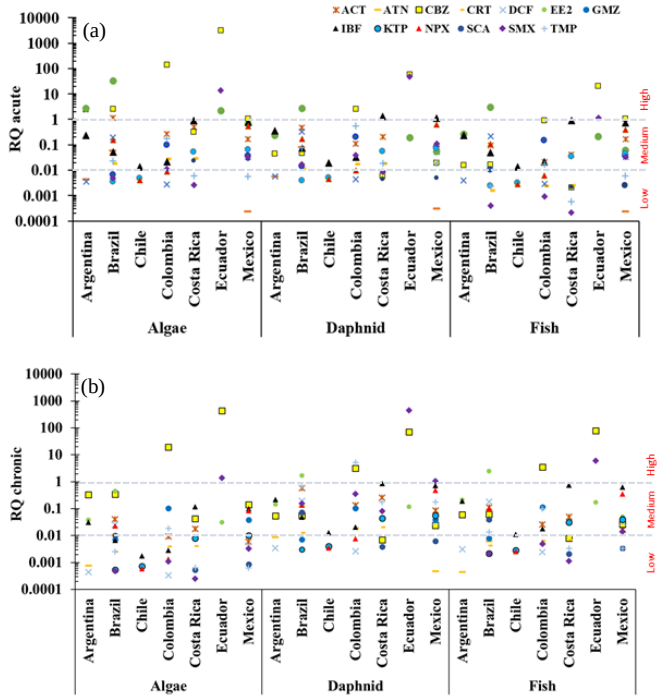


Fig. 4 Summary of the Risk Assessment. Acute (a) and chronic (b) Risk Quotient of thirteen PhACs on indicator organisms by country. Dotted lines mark the low, medium and high risk sections.

Thirteen PhACs were found to be of ecotoxicological concern (medium to high environmental risk) for aquatic organisms during the first two decades of the 21st century in LATAM (Fig. 4). Four of them (CBZ, SMX] EE2, and ibuprofen (IBF)) were identified as the potential cause of high acute and chronic ecological risk for the three trophic species in the seven countries with sufficient data for this analysis.

CONCLUSIONS

CBZ and EE2 were found in concentrations high enough to cause stressed environmental damage in rivers that acted simultaneously as receptors of untreated urban wastewater (WW) and as sources of potable water. The individual ecological risk assessment of the maximum concentrations found in LATAM indicates that four of these compounds, CBZ, SMX, EE2, and IBF pose a medium to high risk to aquatic organisms in all of the LATAM countries where measurements were made. Given that urban WW seems to be the source of stressed environmental conditions, this analysis revels that LATAM countries should focus some efforts on developing WW management strategies to prevent even greater environmental damage in the near future.

REFERENCES

Valdez-Carrillo et al. (2020). Pharmaceuticals as emerging contaminants in the aquatic environment of Latin America: a review. *Environmental Science and Pollution Research, 27*(36), 44863-44891.

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