Determination of the impact and occurrence of Emerging Pollutants in rivers of the Ecuadorian Coast and treatment proposals for their removal

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Introduction

Worldwide unregulated contaminants are found in different environmental matrices including water. These pollutants, of diverse nature and origin coming mainly from anthropogenic activities, are called Emerging Pollutants (EPs). The major concern exists because these contaminants reach surface water (e.g. rivers, lakes) through treated and untreated wastewater. Continuous discharges lead to bioaccumulation aggravating public and environmental health problems.

To justify regulation of a pollutant, investigations must be conducted. In this regard, our team is conducting a study which has 3 phases:

1. Occurrence of emerging pollutants in rivers of the Ecuadorian coast
2. Impact of these pollutants in the aquatic environment
3. Treatment of certain emerging pollutants in wastewater before being released into rivers

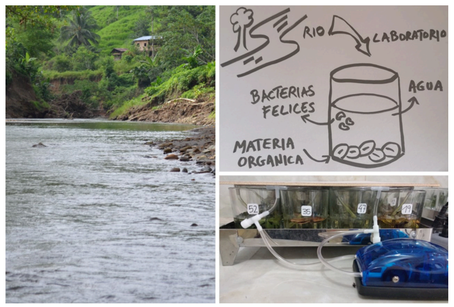
1. Occurrence

This project is focused on surface water samples from Esmeraldas river due to continuous discharges coming from main cities of the Sierra region, including Quito. Also, a previous study by Voloshenko-Rossin, (2015) indicated the presence of several compounds in the Esmeraldas River.

Generally, emerging pollutants are found in concentrations of parts per million or billion, thus, highly sensitive chemical analysis techniques are needed for their analysis. The most widely used is liquid chromatography coupled to mass spectrometry (LC-MS). This technique separates various compounds present in the sample and then identifies them thanks to their unique fractionation pattern. A prior process of solid phase extraction is needed before starting the analysis to eliminate interferences and concentrate the small amounts of analyte in a reduced volume. The experimental protocols of this study are based on the work of Schultz & Furlong (2008).

2. Impact

More than 27.000 chemicals are released into aquatic ecosystems and there is not enough information about their impacts on the Ecuadorian ecosystems nor the human health. Hence, to evaluate the impact, water and microorganisms from different sampling sites are taken to reproduce the process of organic matter decomposition in the laboratory. Adding emerging pollutants of study to sampled water, the environmental risks on aquatic organisms will be evaluated.



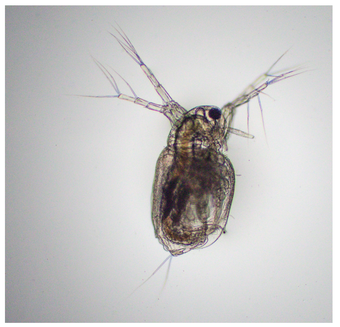
Through laboratory exposure experiments, the concentrations of these compounds that are capable of causing toxicity to the organisms will be known.

3. Treatment

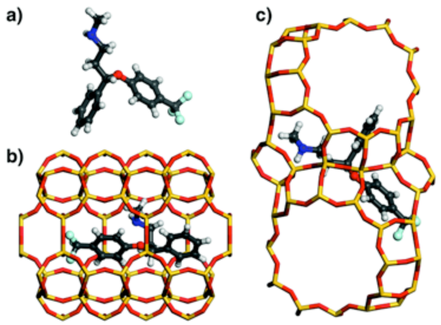
This study will focus on the use of zeolites, bentonites and cladoceras for the removal of EPs in wastewater. Zeolites have been used in water treatments for the removal of surfactants (Diagboya & Dikio, 2018). The use of natural zeolites in combination with other chemical compounds have shown to retain in their structure, sodium diclofenac and ketoprofen (Smiljanić et al., 2020). Bentonites have the absorption capacity of non-ionic polymers (Luckham & Rossi, 1999), and are also used for the removal of heavy metals (Christidis, 1998).

The combination of zeolites and bentonites in water treatment systems has not focused on the removal of specific EPs ("Wastewater Treat. Using Bentonite, Comb. Bentonite-Zeolite, Bentonite-Alum, Bentonite-Limestone as Adsorbent Coagulant", 2013).

Organisms resistant to wastewater environments such as cladocerans, have been also tested on the removal of emerging contaminants.



Daphnia pulex



Adsorption of acetaminophen on a zeolite molecule

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