

Removal of Sertraline in Aqueous Effluents Using Olive Stones

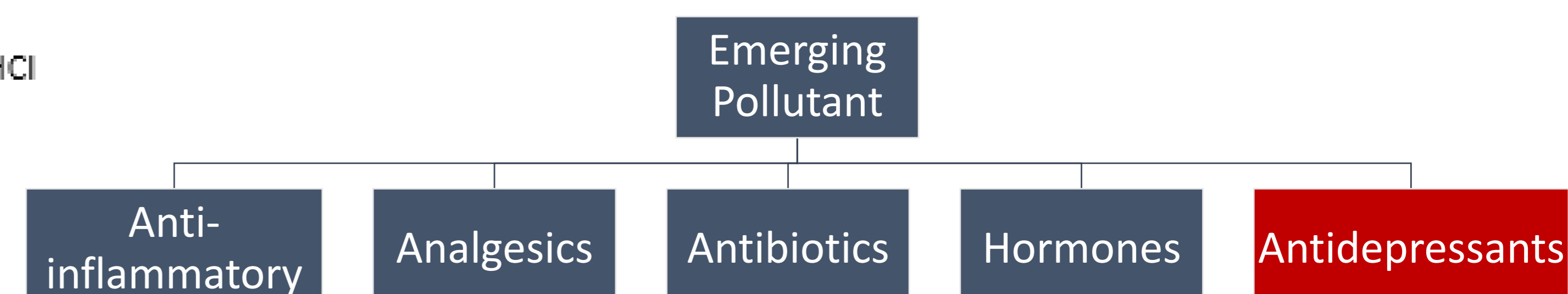
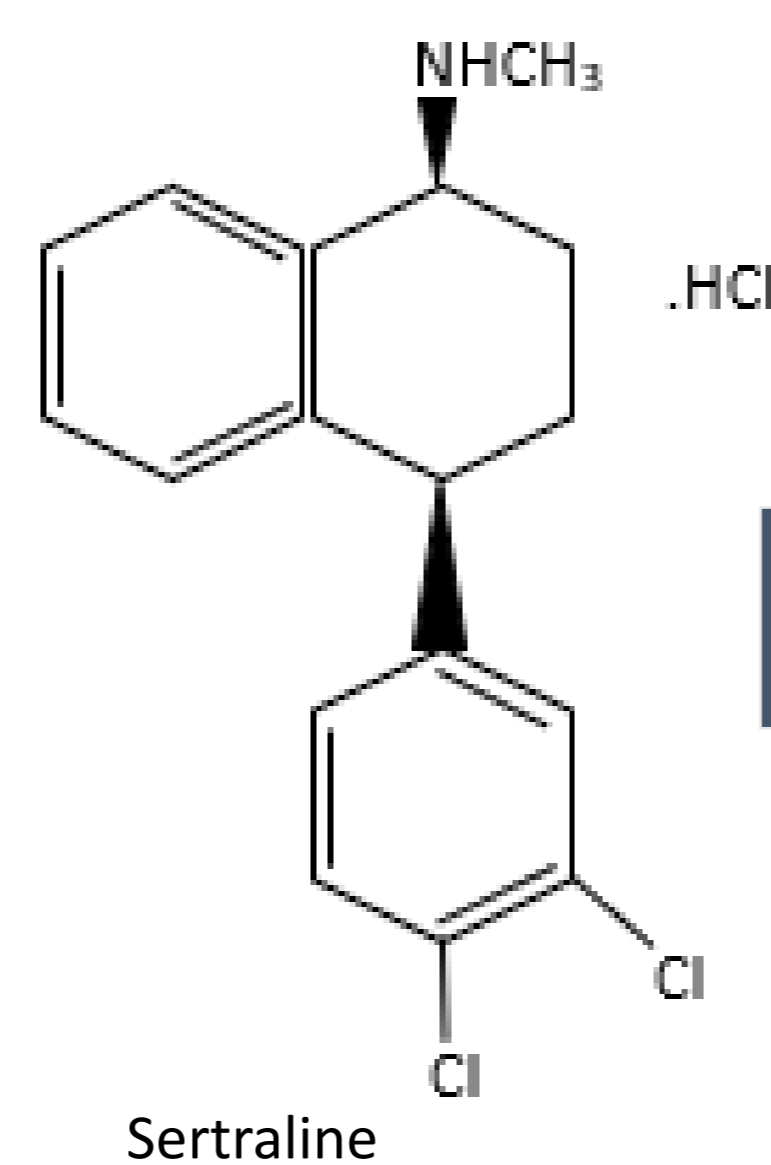
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Sertraline as a Emerging Pollutant

The presence of pharmaceutical drugs, their metabolites and degradation products in the environment requires research and monitoring studies to assess the potential risks to human health and to the ecosystem. This type of compounds is present in the environment in very low concentrations, in the order of magnitude of $\mu\text{g}\cdot\text{L}^{-1}$ and $\text{ng}\cdot\text{L}^{-1}$, which requires an optimization of the removal processes, so that they are simpler, faster, cheaper and more environmentally friendly than traditional techniques.¹ There are several possible sources and routes for drugs to reach the environment, but wastewater treatment plants (WWTP) have been identified as one of the main sources. After the treatment carried out at the WWTP, the treated effluents are discharged into rivers, and the sludge produced is disposed of or reused in agriculture as a fertilizer. As a consequence of the incomplete elimination of drugs and metabolites in the WWTP, these compounds end up reaching almost all the environmental matrices.² For this study, sertraline was chosen because it is one of the most prescribed antidepressants in recent years in Portugal. Therefore, it is not surprising that it is regularly detected in wastewater, surface water and sediments and in WWTP.³ The main objective of this study is to experimentally implement an expeditious method using high performance liquid chromatography with diode array detector (HPLC-DAD) to monitor sertraline concentration levels in aqueous matrices and study the removal of sertraline by adsorption using olive stones activated carbon.



Equipment and Methodology

Analysis and Quantification

- HPLC-DAD
A Jasco HPLC-DAD system with a SiliaChrom® XT C18 analytical column (pH 1 to 12)



Method Validation

- Calibration curve linearity
- Limit of quantification
- Limit of detection
- Precision
- Accuracy
- Validation using a real sample (commercial sertraline)

Olive Stone Activation Carbon (OSAC)



OSAC particles
0,25 mm diameter
("bio-based raw-material")

Activation:

- Add 10% aqueous solution of sulfuric acid in a proportion of 1:3 in 50 g of adsorbent
- Wash the adsorbent with 1000 mL of distilled water
- Dry for 6 h at ambient temperature
- Dry in oven at 110°C for 24 h
- Carbonize in a muffle at 550°C for 90 min

Characterization of OSAC:

- FTIR spectra before and after activation
- Surface area (methylene blue adsorption)
- Humidity and Percentage of ash
- Piezoelectric point (Superficial charge)
- Acidic and alkaline sites (Boehm titration)

Equilibrium Adsorption Isotherm experimental data measurements

Study the adsorption equilibrium :

- Effect of contact time
- Effect of pH
- Effect of adsorbent dosage
- Effect of sertraline concentration
- Maximum adsorption capacity

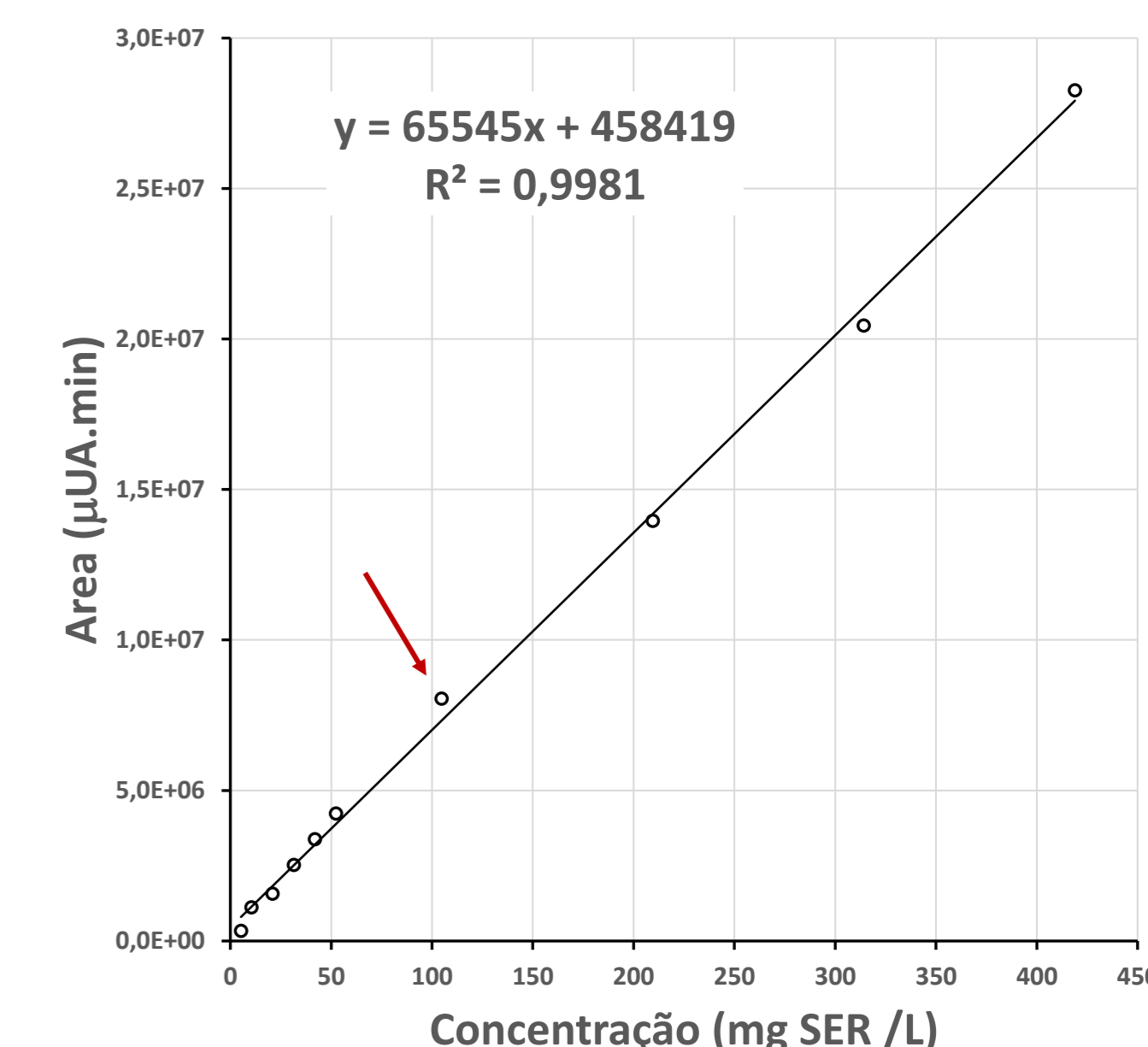
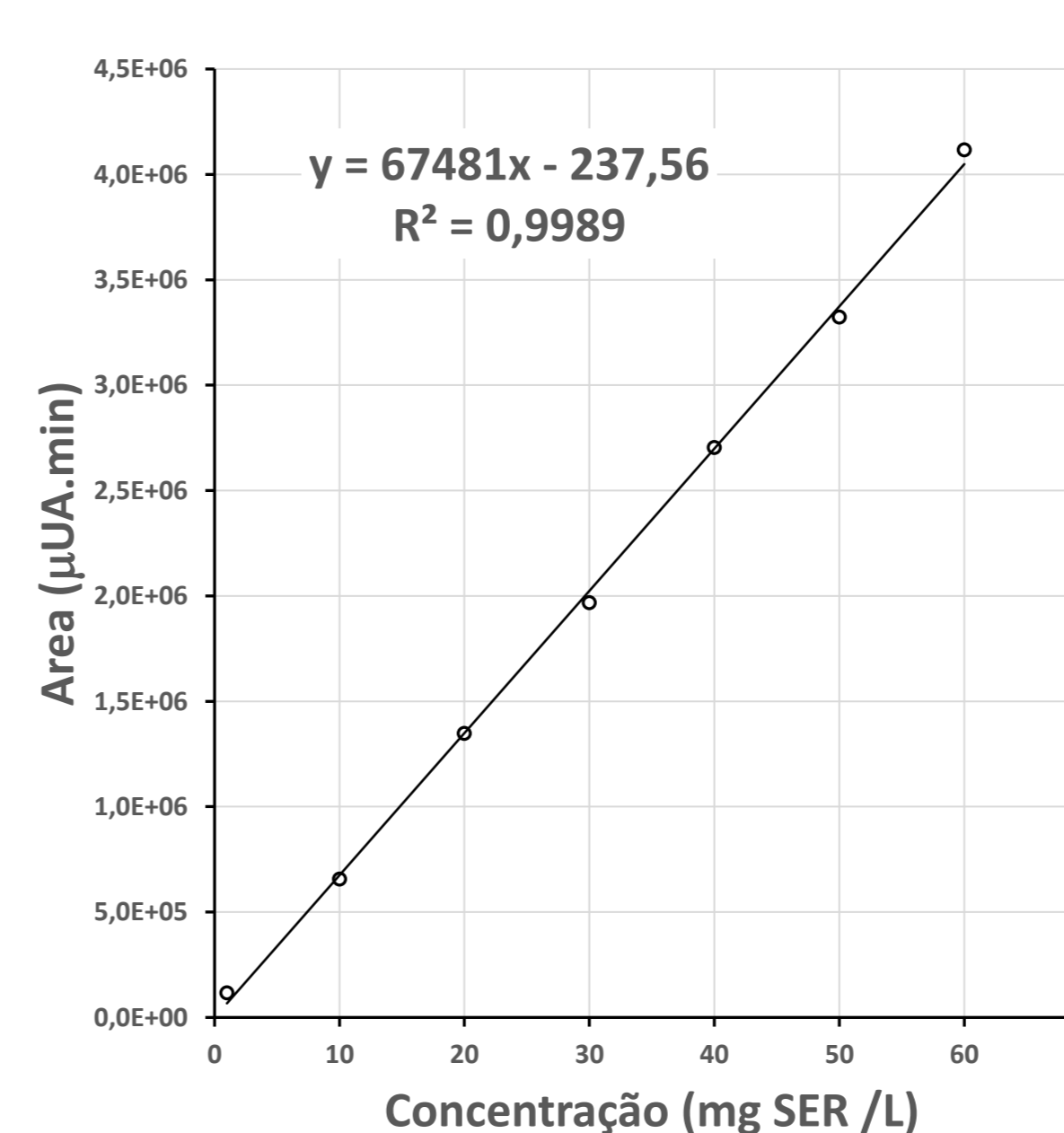
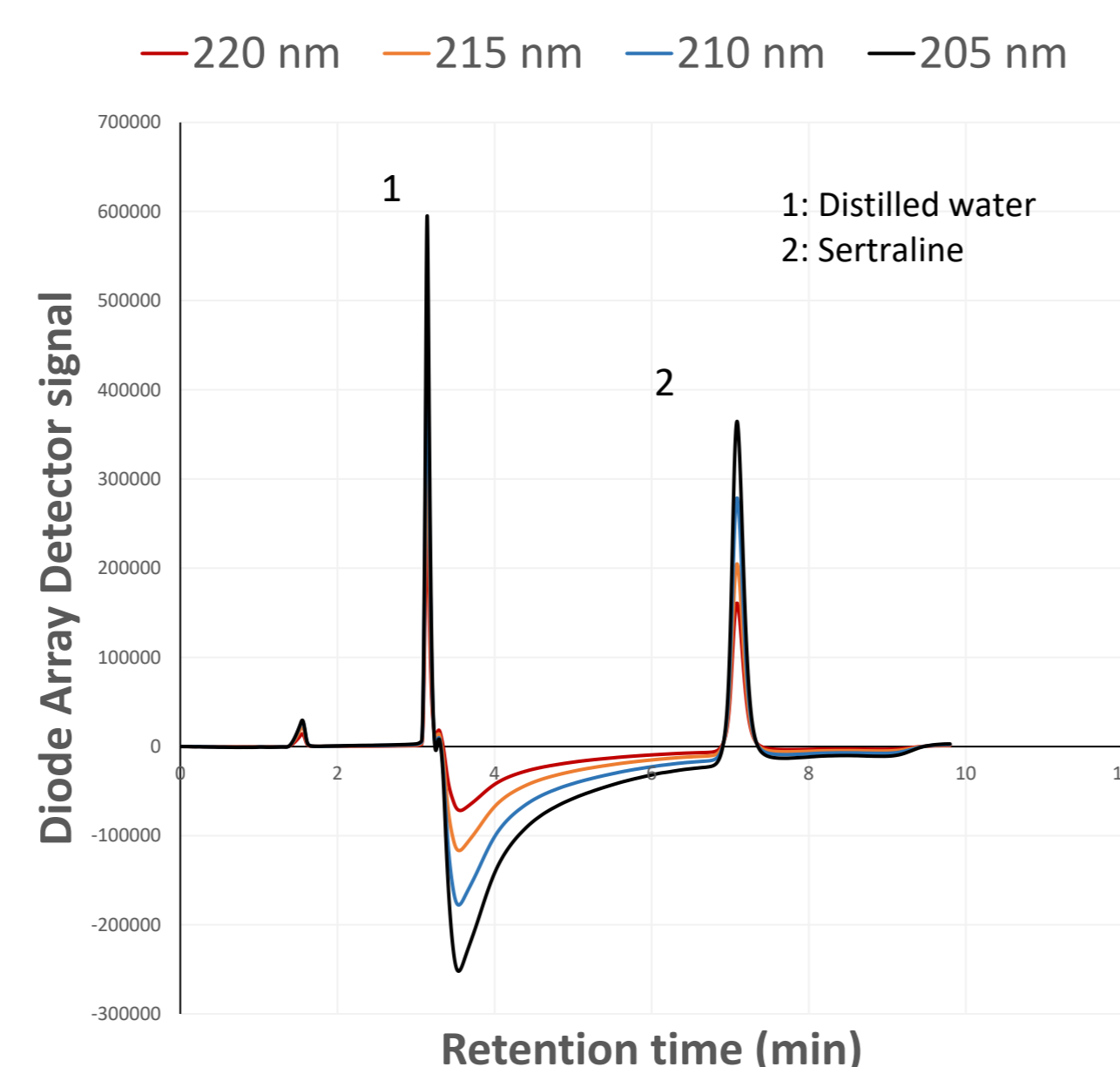
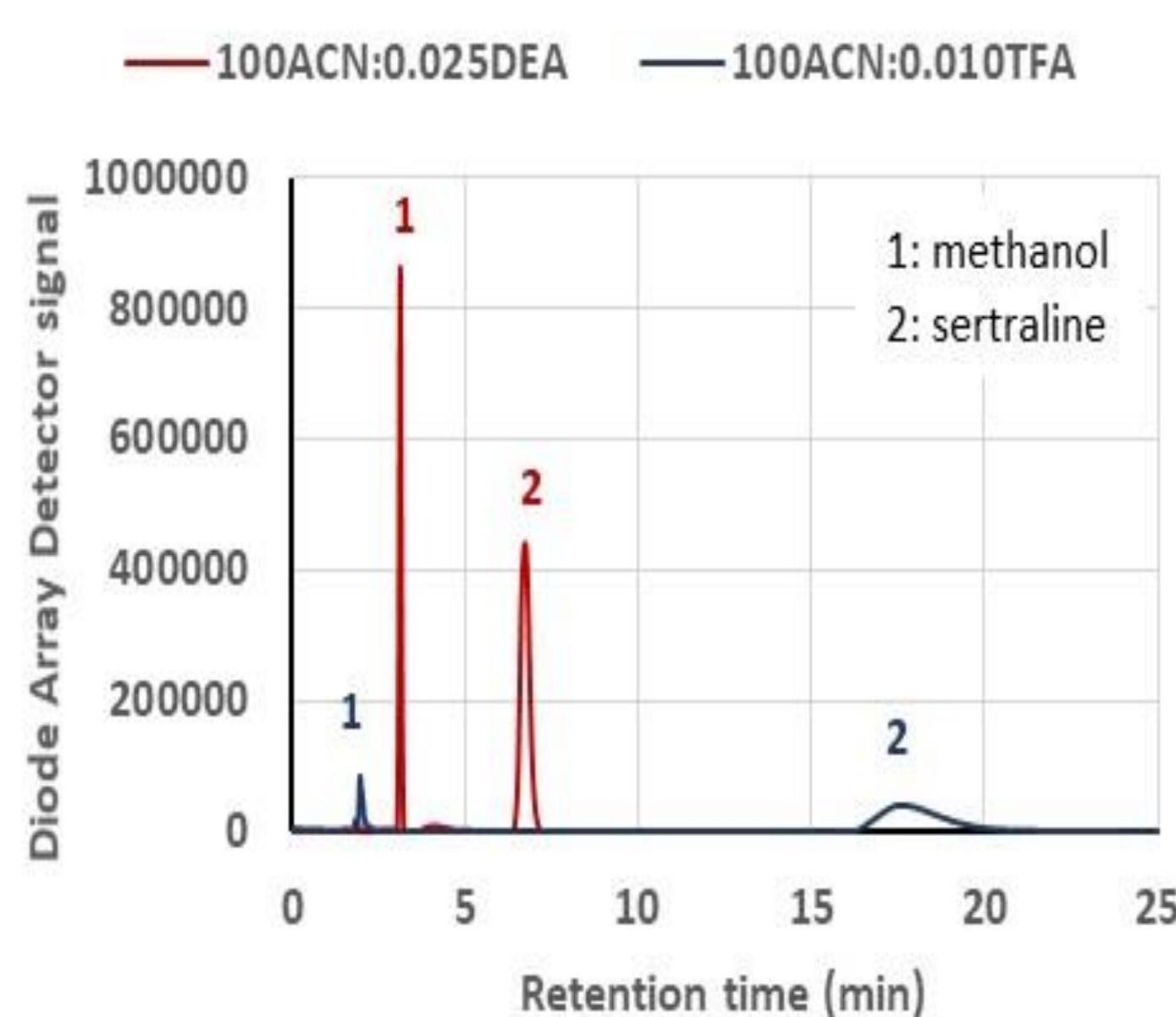
Experimental data fitting to an adsorption model:

- Langmuir model
- Freundlich model
- BET model
- Temkin model

Study the kinetics of sertraline adsorption onto OSAC

- Fitting of a reaction order
- Estimation of rate constant

Results and discussion



The use of mobile phase with a composition of pure acetonitrile with DEA (pH 10.8) represents less retention time and also less dispersion, which is a significant factor for a complex and real mixture as an aqueous effluent.

The comparison between a 20 mg/L sertraline solution using 220, 215, 210 and 205 nm DAD wavelengths shows that the use of 205 nm allows to increase the detector signal with no important effect on the quality sertraline identification and quantification.

The determination of sertraline calibration curve in pure methanol as solvent, has a very good linearity between 1 and 60 mg/L. The obtained precision and accuracy are below 5%.

Using a commercial "100 mg sertraline" pill, a second calibration curve was determined using distilled water to mimic the real matrix. For this calibration curve obtained from 10 to 400 mg/L the linearity was also assured. The analysis of the commercial pill indicate a mass of 117 mg of sertraline.

On-Going work

Absorbent Characterization:

- Moisture
$$H\% = \frac{m_0 - m_1}{m_0} \cdot 100$$
- FTIR analysis
- Ash percentage
$$\% = \frac{P_1 - P_2}{P_1}$$

Determination of balance parameters:

- Langmuir
$$\frac{C_e}{q_e} = \frac{C_e}{q_m} + \frac{1}{K_f q_m}$$
- Freundlich
$$q_e = K_f C_n^{1/n}$$
- BET
$$\frac{C_e}{q_e(C_0 - C_e)} = \frac{1}{q_m \cdot K} + \frac{K - 1}{q_m \cdot K} \left[\frac{C_m}{C_0} \right]$$

References

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Acknowledgements

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