EXTRACTION AND DETERMINATION OF ANTINEOPLASTIC COMPOUNDS IN WATERS FROM MARINE OUTFALLS BY SOLID PHASE EXTRACTION AND ULTRA-HIGH PERFORMANCE LIQUID CHROMATOGRAPHY

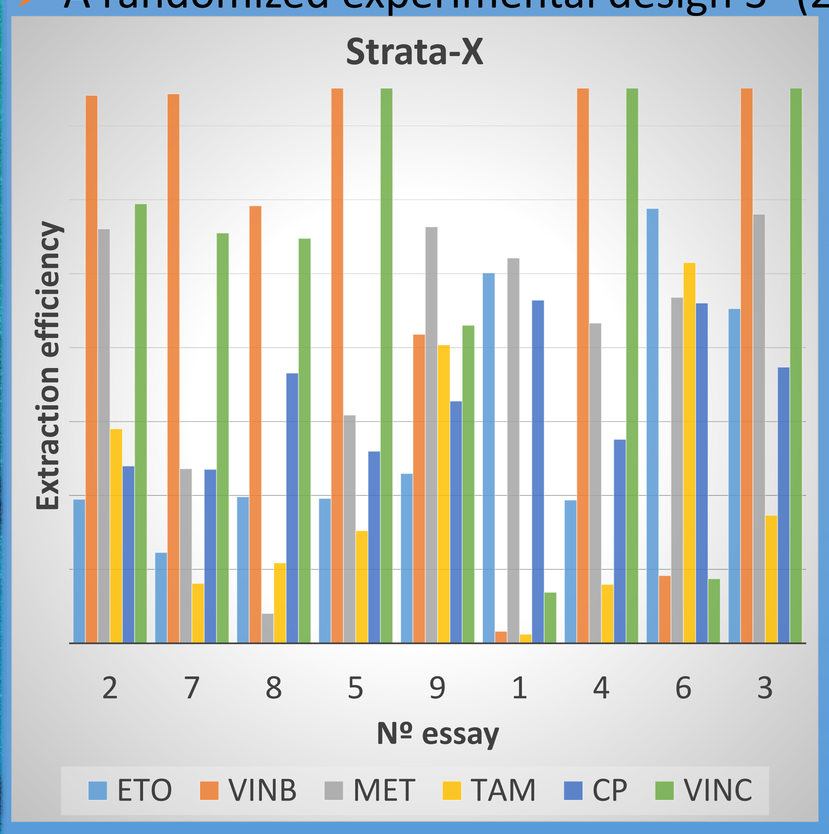
Sergio Santana-Viera, Patricia Hernández-Arencibia, Zoraida Sosa-Ferrera, José Juan Santana-Rodríguez.
Instituto Universitario de Estudios Ambientales y Recursos Naturales (i-UNAT), Universidad de Las Palmas de Gran Canaria, 35017 Las Palmas de Gran Canaria, Spain

INTRODUCTION

- Concentrations in the $\mu g \cdot L^{-1}$ range of several of antineoplastic compounds have been detected in effluents from hospitals in the range of $\mu g \cdot L^{-1}$ and in influents and effluents from wastewater treatment plants in the range of $ng \cdot L^{-1}$ [1]. The fact that the antineoplastic compounds are detected in effluents means that the treatment plants are not efficient in the elimination of these compounds causing them to be detected in river and surface water [2,3].
- On the other hand, it has been shown that exposure to low concentrations (120 $ng \cdot L^{-1}$) of Daphnia pulex to tamoxifen causes adverse effects [4], which is a concentration no much higher than those found in some effluents, where the mixture of several antineoplastic compounds can be even worse than separately.
- For this reason it is necessary to optimise sufficiently sensitive techniques for the detection of said compounds in different water bodies.

EXPERIMENTAL

- Bond Elut, Isolute ENV+, Oasis HLB and Strata-X cartridges were tested.
- Six antineoplastic compounds were selected: Etoposide (ETO), Vinblastine (VINB), Methotrexate (MET), Tamoxifen (TAM), Cyclophosphamide (CP) and Vincristine (VINC)
- A sample volume of 250mL was selected, since a higher volume could clog the cartridges.
- A randomized experimental design 3^2 (2 variables at 3 levels) was carried out with the pH and ionic strength.



- Essay nº 2 was selected (pH = 2, ionic strength = 5%), since it offered good results for most compounds.
- Because the ionic strength of seawater is close to 5%, we continued working with the ionic strength of seawater.

ANALYTICAL PARAMETERS AT 0.5 $\mu g \cdot L^{-1}$

Compound	Recovery	LOD ($ng \cdot L^{-1}$)	LOQ ($ng \cdot L^{-1}$)	Matrix effect	RSD Intraday	RSD Interday
ETO	120,03	1,06	3,55	-6,42	10,34	13,33
VINB	90,65	3,66	12,20	49,83	12,34	15,52
MET	134,88	5,14	17,13	66,78	11,03	13,93
TAM	68,58	0,95	3,15	-75,68	9,27	15,44
CP	132,52	3,10	10,33	-85,17	10,63	1,92
VINC	102,93	1,96	6,54	73,96	14,68	10,93

CONCLUSIONS

- A sensitive method, based on SPE extraction and UHPLC-MS/MS quantification, was optimized and validated for the simultaneous determination of different antineoplastic compounds in seawater samples from marine outfalls.
- Absolute recoveries higher than 68% for all compounds were obtained and LODs ranged between 0.95 – 5.14 $ng \cdot L^{-1}$.
- Due to the matrix effect it is necessary to perform a matrix match calibration for quantification.
- Seawater samples were analysed from three marine outfalls taken at the bottom of the sea and the surface in several months; however, no antineoplastic compounds were detected.

REFERENCES

[1] Santana-Viera, S., Montesdeoca-Esponda, S., Sosa-Ferrera, Z., Santana-Rodríguez, J. J., TrAC Trends Anal. Chem. 2016, 80, 373–386.
[2] Buerge, I. J., Buser, H.-R., Poiger, T., Müller, M. D., Environ. Sci. Technol. 2006, 40, 7242–7250.
[3] Ferrando-Climent, L., Rodriguez-Mozaz, S., Barceló, D., Environ. Pollut. 2014, 193, 216–223.
[4] Borgatta, M., Waridel, P., Decosterd, L.-A., Buclin, T., Chèvre, N., Sci. Total Environ. 2016, 545–546, 21–29.

This work was supported by funds provided by the Spanish Ministry of Economy and Competitiveness [Research Project CTM2015-66095-C2-1-R]. Sergio Santana-Viera thanks the University of Las Palmas de Gran Canaria (Spain) for his Ph.D. student grant.