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# **BOOK OF ABSTRACT**

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## CHARACTERIZATION AND MONITORING OF UV FILTERS IN SUNSCREENS BY VOLTAMMETRIC METHODS

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### 1. Introduction

Sunscreens are useful since they protect the skin against radiations, which may be responsible for harmful photochemical reactions to the body. Sunscreens involve the use of appropriate sun-blocking agents. In particular, ultra-violet filters (UVF) are inorganic and organic chemicals used to attenuate the negative effects of sunlight exposure on both human skin and synthetic materials. In order to enhance the sun protection factor values, several combinations of UVF are used, so their total concentration in the final products increases. Organic substances containing chemical groups that can filter UVA and UVB radiation are used as active ingredients of sunscreen formulations. Some of those approved in the manufactured formulations are octocrylene (OCR) and 2-Hydroxy-oxybenzone (BENZO-3) [1]. However, some chemical sun-blocking agents can be almost as damaging as UV radiation itself, making the effects of some sunscreens questionable and are considered as contaminants of emerging concern (CEC). Despite many organic UVF are electroactive, only few papers reporting electrochemical methods for their determination are reported [2].

### 2. Results and Discussion

In this context, the present work aims at evaluating the applicability of voltammetry to monitor sunscreen quality and composition. The sunscreens under study were purchased in pharmacies and supermarkets in the province of Turin. Carbon Paste Electrodes (CPEs) have been obtained by mixing an aliquot of graphite powder and an aliquot of each sunscreen were used to test the resistance of creams to exposure to sunlight using a solar box. The redox anodic and cathodic profiles of each sunscreen embedded in the paste were recorded by square wave voltammetry (SWV). The voltammograms of each sample were recorded just after opening the cream vessel and after 1h, 3h and 5h of exposure in the solar box. Some modifications in the redox profile at different times was observed; in particular, a significant decrease of the peak intensities was observed. Also, the stability of a standard OCR in seawater exposed to sunlight for several days was tested, in comparison with another aliquot of the same sample solution stored in the dark and in the fridge. A rapid decrease in the peak of the OCR for the sample exposed to the sun was observed.

In the second part of the work the possibility to apply voltammetry to monitor and to quantify the concentration of some sunscreen agents was tested. For this purpose, a Glassy Carbon Electrode (GCE) was used. Different solutions were used as supporting electrolyte (NaCl) and a buffer (Britton-Robinson). Suitable experimental parameters were identified and the linearity, the repeatability, the detection limit, and the accuracy were determined. Then, the applicability of the proposed technique for the determination of UV-filter residues in seawater was evaluated. In this case, aliquots of seawater were spiked with different amounts of products, and the standard addition method was used to quantify sunscreen agents (for example, octocrylene) as shown in Figure 1.

### 3. Conclusions

The results obtained demonstrated the good applicability of voltammetry for the quality control of sunscreens and for their monitoring in seawaters. In particular, this method coupled with the use of portable instrumentation could permit the application of the technique for on-site analysis. The proposed methods is easy, fast and quite cheap if compared with other official techniques.

Our technique could be used as a screening for the presence or absence of UVF in different environmental matrices, as for example seawater, lake water and solar cream.

The next steps of the work concern the further optimization of the method, the analysis of other UV filters and other types of matrices, and an increase in the number of samples analyzed.

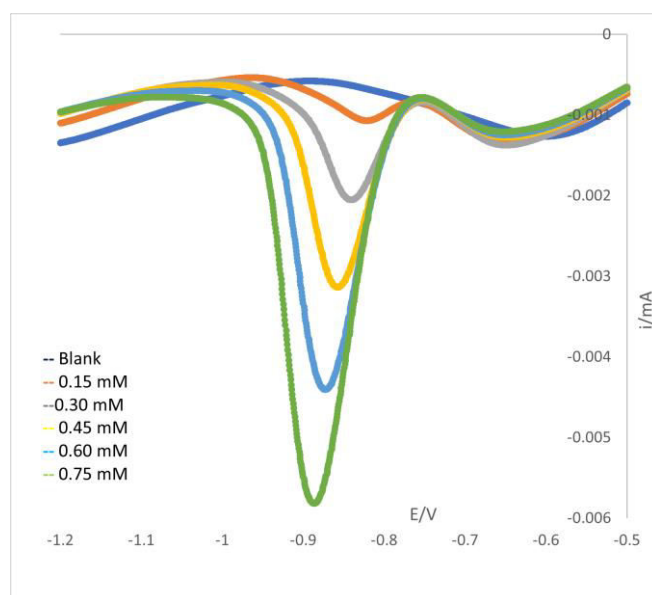


Figure 1. Standard additions (0.15 mM each) of octocrylene in a seawater sample.

## References

- [1] A. Sunyer, A. Gonzalez-Navarro, M.P. Serra Roig, N. Serrano, M.S. Diaz-Cruz, J.M. Diaz-Cruz, *Talanta* 196 (2019) 381-388.
- [2] V. S. Ferreira, J. B. G. Junior, C. M. S.C. Oliveira, R.M. Takeuchi, A.L. Santos, M.A.G. Trindade, *Microchemical Journal* 106 (2013) 378-383.