

Sporopollenin: Applications for diclofenac adsorption

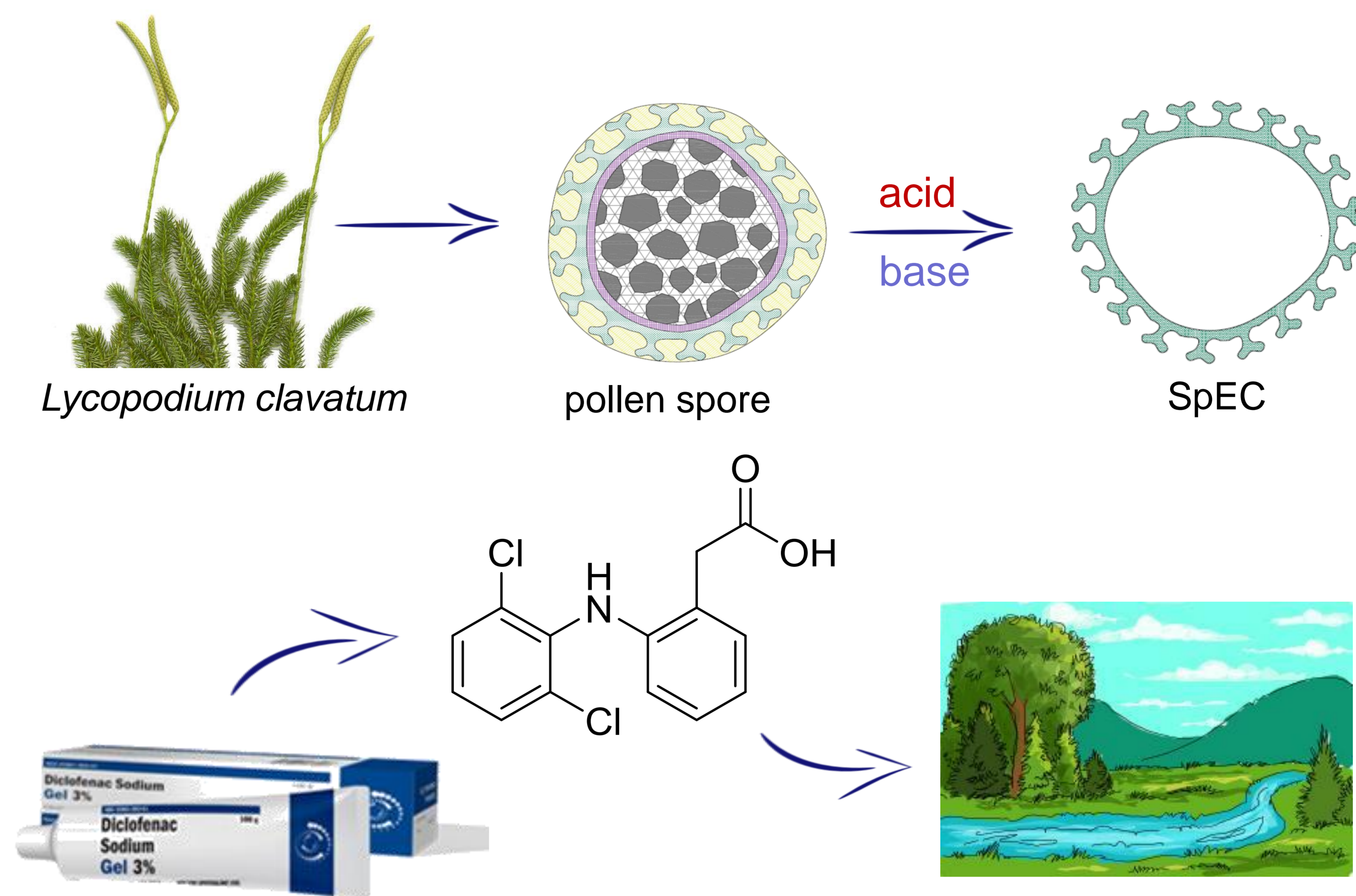
Aimilia Meichanetzoglou^{1*}, Andrew Boa¹ and Jeanette Rotchell²

¹School of Mathematics and Physical Sciences, ²School of Environmental Sciences, University of Hull, Cottingham Road, HU6 7RX, Hull, UK.

*e-mail: A.Meichanetzoglou@2016.hull.ac.uk project website: <http://northsearegion.eu/sullied-sediments/>

1 Introduction

- Sporopollenin:** natural polymer that forms the outer shell (exine) of pollen spores. ¹
- SpECs:** sporopollenin exine capsules extracted from raw pollen. Porous microcapsules with diameter size $35 \pm 5 \mu\text{m}$ and pore diameter size $1-2 \mu\text{m}$. ^{1,2}
- Diclofenac (DCF):** non steroidal anti inflammatory drug present in analgesic gels, creams and tablets. Emerging contaminant due to possible endocrine disrupting properties, bioaccumulation and toxicity to aquatic organisms even at low levels. ³ Wastewater treatment plants inefficient of its complete removal. It is present in surface and wastewater at levels of $0.81-2 \mu\text{g/ml}$. ⁴
- Adsorption:** a surface phenomenon where the concentration of a chemical species (adsorbate) increases onto the surface of a solid (adsorbent). ⁵



2 Aims

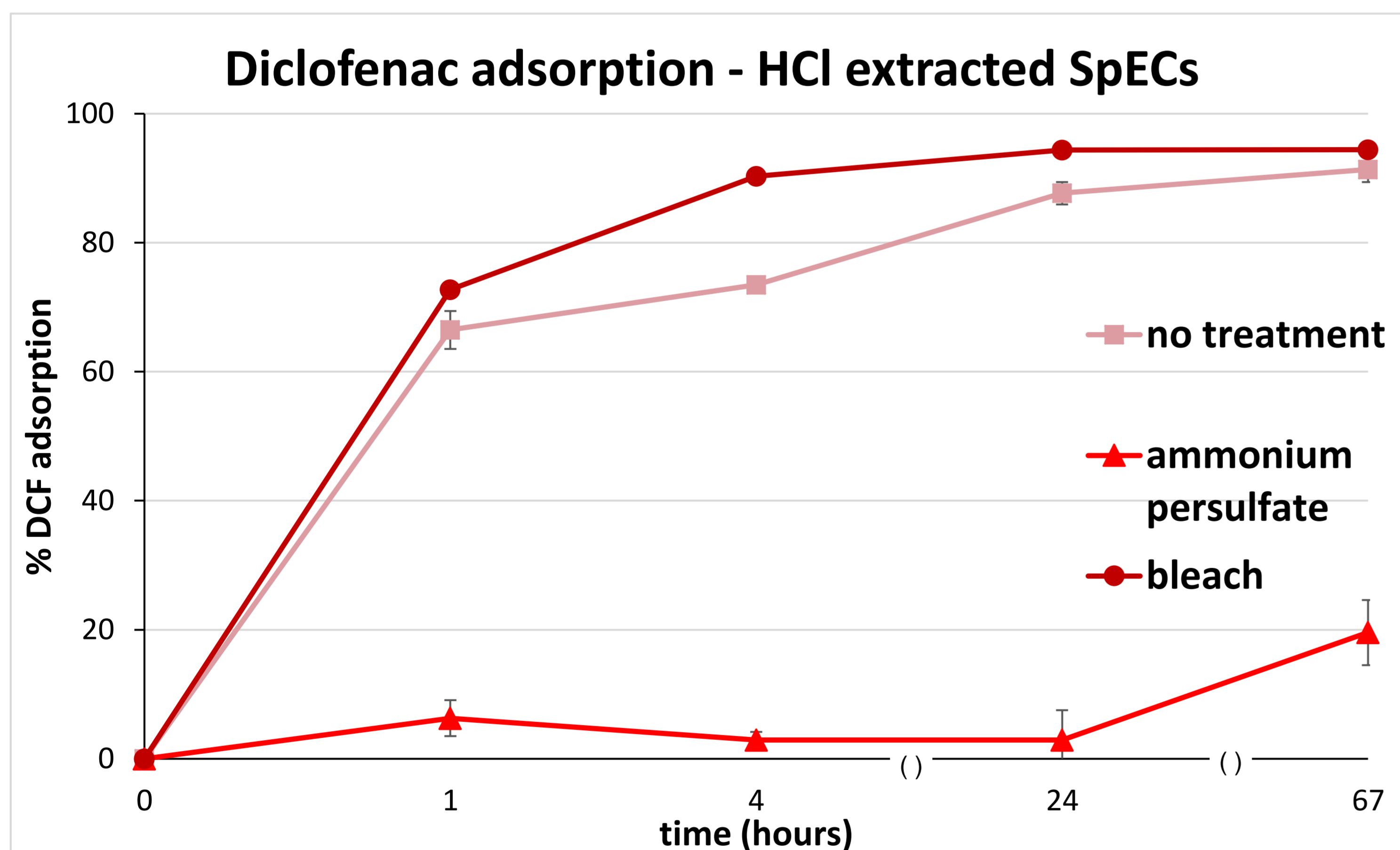
- Water purification with the use of sporopollenin as an adsorbent material.
- 25% diclofenac removal from effluents at waste water treatment plants.

3 Methods

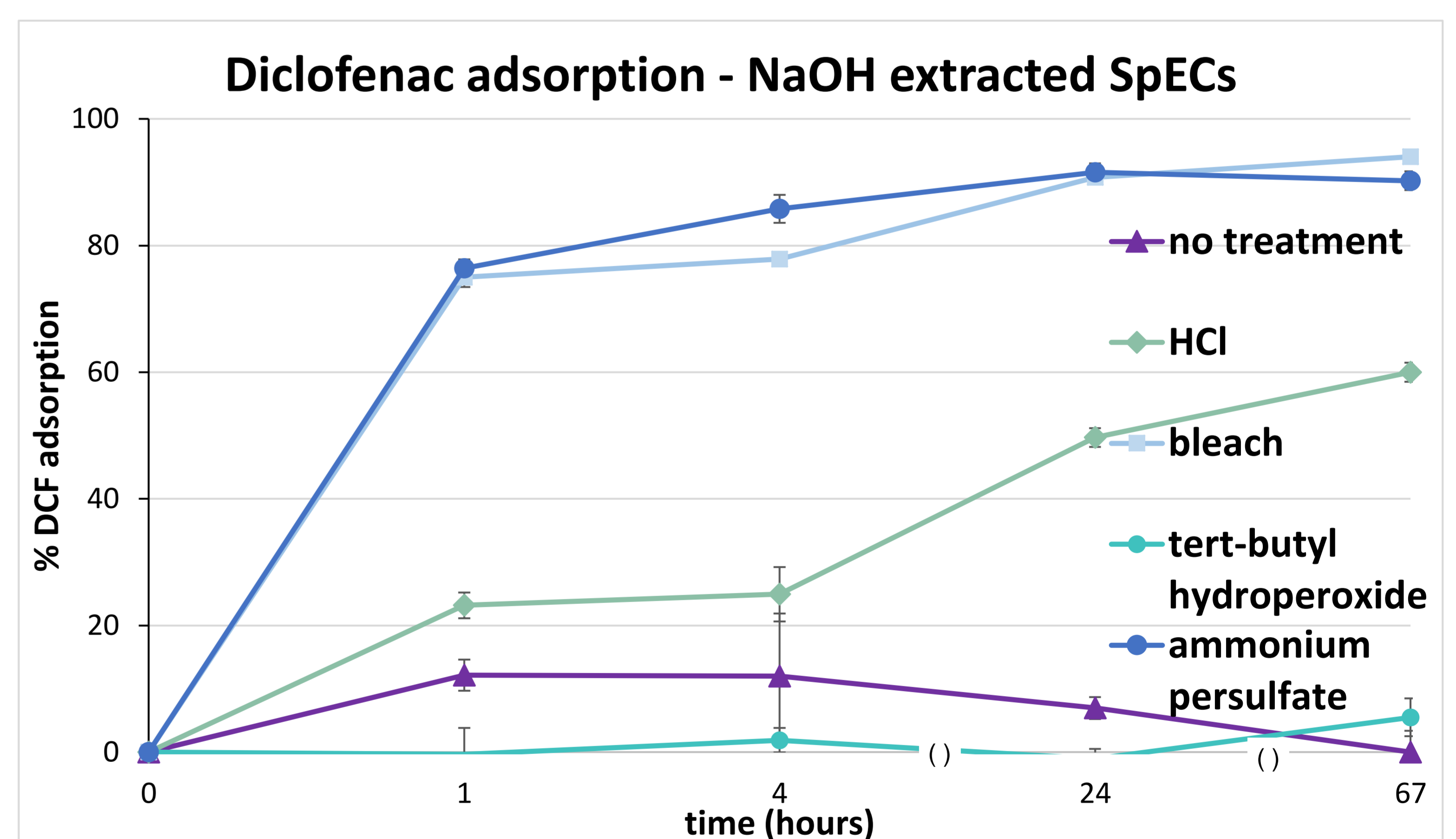
- SpECs extraction from *L. clavatum* raw pollen (e.g. NaOH, HCl).
- SpECs surface modification (e.g. bleach, ammonium persulfate, HCl).
- Diclofenac adsorption experiments to define the most efficient SpEC type
- Quantification of diclofenac concentration via UV-Vis spectroscopy.

4 Results

acid (HCl) SpECs extraction and surface modification



base (NaOH) SpECs extraction and surface modification



5 Conclusions

- HCl extracted SpECs were able to remove almost 85% of the initial diclofenac concentration ($6 \mu\text{g/ml}$) in 24 hours. The treatment with bleach increased their removing efficiency to approximately 95% after 24 hours. Treatment with ammonium persulfate changed their surface properties and the material became inefficient to remove more than 20% diclofenac.
- NaOH extracted SpECs showed weak adsorption properties, they removed only 10% of the initial diclofenac concentration in 4 hours. Treatment with ammonium persulfate gave the best adsorption behaviour, where the material removed approximately 90% diclofenac after 24 hours. Similar results were obtained after treatment with bleach, whereas *tert*-butyl hydroperoxide and HCl treatments did not show great ameliorations in the adsorption properties of the material.

Acknowledgments: This work is part of the Sullied Sediments Project funded by the Interreg North Sea Region European Regional Development Fund.

References:

- M.J. Thomasson, D.J. Baldwin, A. Diego-Taboada, S.L. Atkin, G. Mackenzie and J.D. Wadhawan, *Electrochemistry Communications*, 2010, 12, 1428-1421.
- S. Barrier, A. Diego-Taboada, M.J. Thomasson, L. Madden, J.C. Pointon, J.D. Wadhawan, S.T. Beckett, S.L. Atkin and Grahame Mackenzie, *Journal of Materials Chemistry*, 2011, 21, 975-981.
- A.J. Ebele, M.A. Abdallah and S. Harrad, *Emerging Contaminants*, 2017, 3, 1-16.
- S. Álvarez, R.S. Ribeiro, H.T. Gomes, J.L. Sotelo, and J. García, *Chemical Engineering Research and Design*, 2015, 95, 229-238.
- S.D. Faust and O.M. Aly, *Adsorption processes for water treatment*, Butterworth-Heinemann, 1986