Screening of cyanobacteria producing exopolymers as bioflocculants for microplastics water removal

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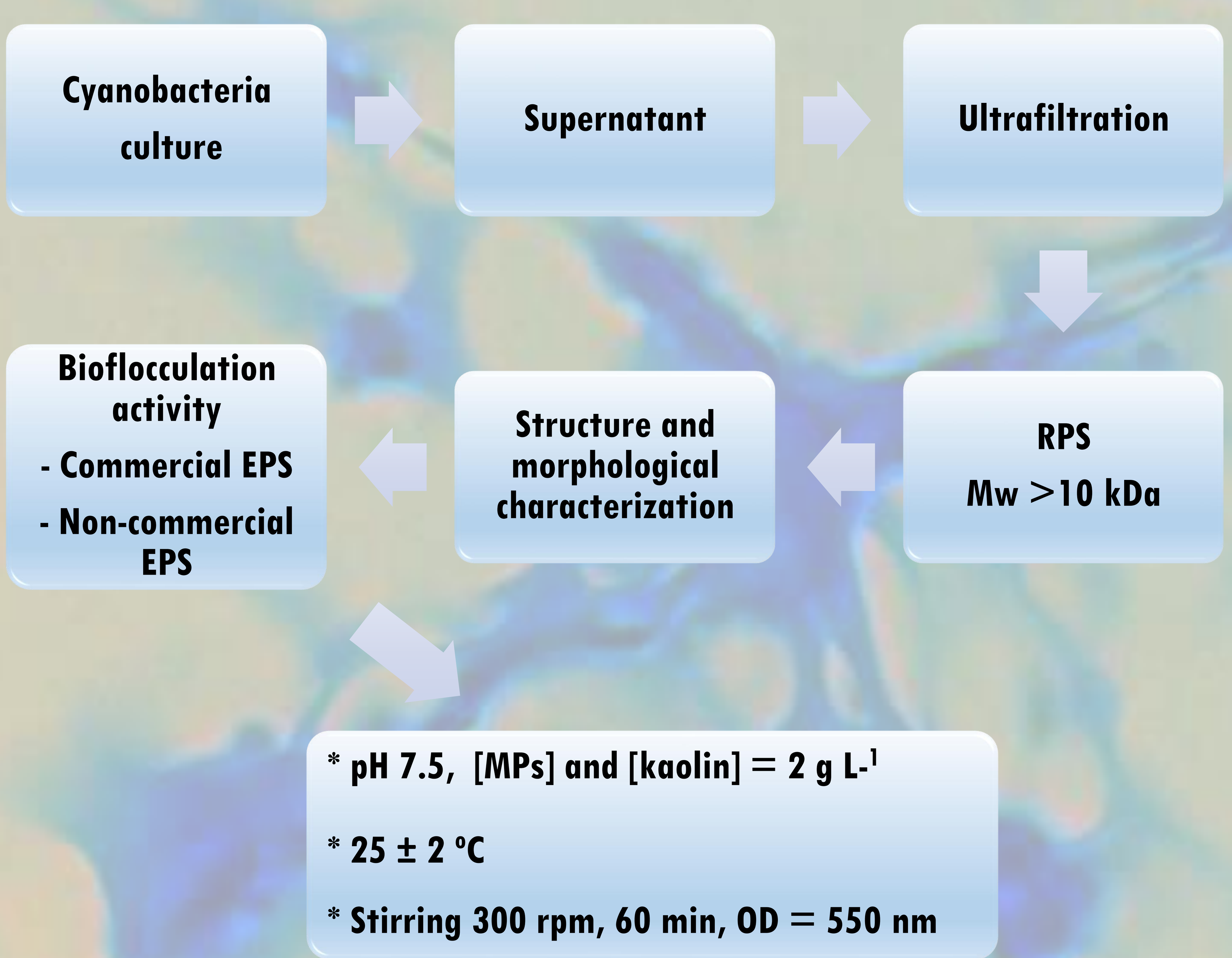
INTRODUCTION AND GOALS

Microplastics have become into a serious problem due to their potential negative effects - from its size to the chemicals released - on the marine ecosystem and biota. The flocculation technique is the most conventional approach to remove the suspended solids in wastewater treatment with high efficiency. However, inorganic, and organic flocculants are employed in this process and most of them stay in the wastewater after treatment and may cause ecological damage [1]. Cyanobacterial-based extracellular substances have been shown encouraging properties suitable to be applied in industry as gums, flocculants, sorbents and emulsifiers [2]. Following our interest on microbial-based biomaterials and the development of an efficient way to remove the microplastics of contaminated water, the main purpose of this research was to assess the bioflocculant activity of different RPS – release exopolymer substances - (*Gloecapsa* sp. – RPS Gsp., *Nostoc commune* – RPS NC, *Cyanocohniella calida* – RPS CC) to remove plastic debris from contaminated water and compare with the flocculant activity of commercial extracellular substances.

METHODS



RESULTS

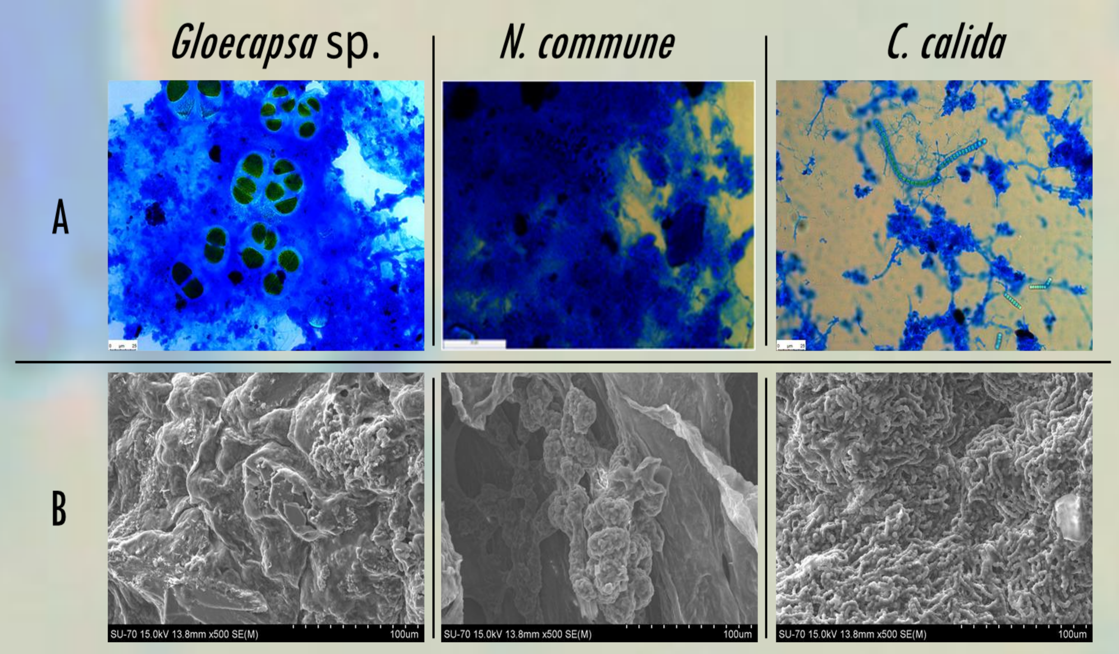


Figure 1. Bright field (A – stained with Alcian Blue) and SEM micrographs (B) of *Gloecapsa* sp., *N. commune* and *C. calida* cells of each extraction steps.

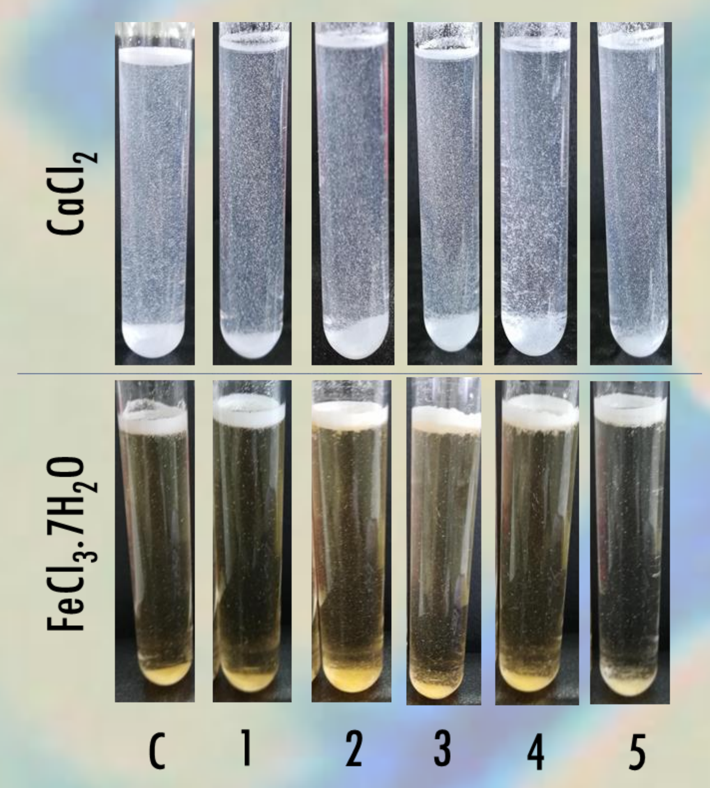


Figure 2. Bioflocculation activity: Xanthan Gum (1), Alginate (2), RPS NC (3), RPS CC 4), RPS Gsp (5), control (C).

Table 1. Flocculation activity of different RPS– exopolymers under different concentrations of cations at 15, 30 and 60 min.

	Kaolin			Microplastics		
	Flocculating activity (%)			Flocculating activity (%)		
	15 min	30 min	60 min	15 min	30 min	60 min
			1% $CaCl_2$			
Alginate	45.1 ± 1.7	55.5 ± 0.6	69.7 ± 5.6	22.5 ± 8.2	24.2 ± 0.5	27.5 ± 0.2
Xanthan gum	75.6 ± 16.6	78.3 ± 5.8	77.0 ± 10.2	25.9 ± 3.4	29.6 ± 2.5	35.2 ± 6.2
RPS NC	19.3 ± 1.7	2.1 ± 0.6	32.7 ± 3.1	17.6 ± 0.1	27.2 ± 1.6	36.8 ± 7.4
RPS CC	57.1 ± 4.4	61.5 ± 9.6	67.9 ± 0.9	15.5± 0.2	12.7 ± 2.2	23.1 ± 6.3
RPS Gsp	15.8 ± 1.9	29.4 ± 9.1	24.0 ± 7.1	4.7 ± 0.1	7.7 ± 0.0	4.5 ± 0.1
			1% $FeCl_3.7H_2O$			
Alginate	15.2 ± 1.3	26.3 ± 0.3	28.6 ± 2.0	21.0 ± 2.4	11.5 ± 3.8	4.4 ± 1.0
Xanthan gum	2.6 ± 0.5	2.8 ± 0.8	3.5 ± 0.3	20.3 ±7.7	16.0 ± 2.3	13.4 ± 0.1
RPS NC	1.0 ± 0.8	0.2 ± 0.157	1.7 ± 0.3	6.3 ± 0.1	11.0 ± 0.7	11.4 ± 4.3
RPS CC	6.0 ± 2.0	3.3 ± 0.6	3.8 ± 0.5	2.48± 0.9	23.0 ± 0.7	9.9± 3.2
RPS Gsp	1.8 ± 0.7	0.9 ± 0.8	0.4 ± 0.2	24.4 ± 5.0	28.4 ± 6.2	18.1± 7.1

CONCLUSIONS

Gloecapsa sp. and *N. commune* cultures demonstrated to be a potential source of RPS with high flocculant activity to remove microplastics of contaminated water - applicability in bioremediation.

- RPS Gsp exhibited the highest bioflocculating activity to remove microplastics (about 28%) after 30 min with Fe^{3+} cation.
- RPS NC displayed a bioflocculating activity to remove microplastics (about 37%) after 60 min when Ca^{2+} cation was applied.

REFERENCES

[1] Rebah, F.B., Mnif, W., Siddeeg. S.M. (2018) Symmetry, 10, 556. https://doi.org/10.3390/sym10110556

[2] Cruz, D., Vasconcelos, V., Pierre, G., Michaud, P., Delattre, C. (2020) Applied Sciences, 10, 3763. https://doi.org/10.3390/app10113763

Acknowledgements: PCT-MAC 2014-2020 , project REBECA-CCT (MAC/1.1.B/269)
Oceanic Observatory of Madeira Project (M1420-01-0145-FEDER-000001)

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23-27 NOVEMBER 2020 LANZAROTE AND BEYOND
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