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A Modified Crustacean Biorefinery Approach: Carotenoids Extraction and Porous Magnesian Calcite Powder

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Abstract

Crustacean shells are a type of food waste with widely recognized valorisation potential within the circular economy. The usual shell biorefinery approach comprises carotenoids extraction, then obtaining proteins, and finally demineralisation to dissolve the calcium carbonate and obtain chitin, as described, for instance, in references [1] and [2]. In the current study, we propose another valorisation approach which avoids the destruction of natural shell nanoporous composite, and rather uses it as a novel adsorbent material for water pollutants removal. Although there are not many reports specifically targeting the porosity of biogenic calcites, our recent project laid down the foundation of native crab shells porosity investigation and their applications potential [3]. Indeed, the literature reports the effectiveness of powdered shells in water purification, Moving further, here we present simple processing methods, such as thermal, acidic and alkaline treatments to obtain different composition and improved porosity of the material. To demonstrate this view, carotenoids were firstly extracted for a batches of 300 g of the blue crab (*Callinectes sapidus*) shell fragments using acetone immersion method. This results in a solution containing 6.5 to 7.2 mg carotenoids, which were submitted to purification, while the residual shells were grinded to micrometric powder using a vibratory disc mill. TGA measurements of resulting powder, in argon gas, show distinct temperature ranges where organic matter and chitin degrade (250 – 370 °C, finally followed by decarboxylation of $CaCO_3$ (620 – 740 °C). These temperature steps have been used to effectively conduct purpose-oriented thermal treatment of the shell powder. Our porosity measurements by the BET method show that the pore surface area firstly increased from 8.21 m^2 g^{-1} in shells powdered in native state to 32.94 m^2 g^{-1} in those powdered after extraction. The porosity can be further improved to over 90 m^1 g^{-1} by alkaline treatment, followed by acidic treatment with intermediate calcination at 500 and 700 °C using a proprietary method in preparation patent submission. Hence our findings allow the

improvement of adsorbents from crab shell waste with tailored structural properties.

Keywords: crustacean shells, porosity, adsorbent material, carotenoids, chemical composition

References

[1] Hülsey, M.J. Shell biorefinery: A comprehensive introduction. Green Energy & Environment, 2018,3: 318-327.
[2] Vincente, F.A., Ventura, S.P.M., Passos, H., Dias, A.C.R.V., Torres-Acosta, M.A., Novak, U., Likozar, B. Crustacean waste biorefinery as a sustainable cost-effective business model. Chem. Eng. J. 2022, 442: 135937.
[3] The BlueBioSustain project, URL: https://bluebiosustain.granturi.ubbcluj.ro/dissem.html (accessed 15. June 2023).

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