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Valorization of crustacean shell residues: fractionation of proteins by microwave-extraction and applications of the residual solid

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Abstract

The fishing and food industry generates large amounts of crustacean shells as waste from their processes. These shells contain 20-30% of chitin, 30-50% of minerals (mainly calcium carbonate - $CaCO_3$), 30-40% of proteins and other compounds in smaller amounts, such as lipids and pigments [1–3]. Chitin and its derivative, chitosan, are highly demanded products due to their interesting applications. Global valorization of crustacean shells may include protein recovery and development of applications for minerals. In the conventional process for the separation of chitin and its subsequent purification from the crustacean shells, three chemical processes are necessary: deproteinization, demineralization and decolorization, and chemical reagents potentially harmful to the environment are used for each of these steps [1,3]. To avoid the drawbacks realated to chemicals, development of greener and more efficient processes are under development for the valorization of this waste biomass [1,2].

In this context, this project aims to develop a biorefining process for the valorization of shrimp molting shells, by sequential fractionation with non-conventional techniques to obtain two differenciated products: 1) a protein concentrate and 2) a chitin-calcium carbonate composite that will be used as platform material for catalyst development and films production.

Initial composition of the raw material, *Litopenaeus vannamei* shrimp moult shell, is 53.7 ± 0.5% (g/100 g of dried shell) of ash (mineral), 3.8 ± 0.9% of fatty acid, 17.8 ± 0.7% of chitin (crude fiber), 10.6 ± 0.4% of protein, and 1.37 ± 0.12% of amino acids. The finded

chemical distribution in the shell agrees with the literature, where the molt shell has a higher mineral content compared to the amount in shells of adults animals of the same species [4].

Under optimized conditions (T: 210 °C, t: 6 min, S/F: 60 mL/g), 90% of the initial amount of proteins and amino acids have being recovered by microwave-assisted extraction using only water as solvent [5]. The residual solid from this aqueous extraction supposes a 60% of the initial solid mass, and is being characterized by elemental analysis, XRD, FTIR, and SEM. This solid will be studied for industrial application as a catalytic support [6,7] and for the production of biofilms [8,9].

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