Residual orange biomass derived porous materials

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Millions of tons of side-streams are produced every year by the orange juice industry. When disposed, this by-product can lead to environmental and public health problems, e.g. contamination of groundwaters, disruption of the soil microbiome, and pests proliferation. A promising strategy for upcycling this residual biomass is its conversion into new bio-based materials, harnessing their high content of biopolymers. Their valorization without extensive isolation or purification is especially interesting; however, the use of orange waste as raw material for making porous materials, aerogels and cryogels, has not been explored yet. Aqueous suspensions of orange biomass were prepared through a simple, mild hydrolysis treatment with citric acid followed by heating and homogenization. Three fractions were used, namely, peels, bagasse, and residual pulp, and aqueous suspensions were made. Nonsolvent-induced phase separation, with ethanol or acetone, was performed prior to supercritical drying with carbon dioxide (scCO2) to obtain citrus biomass-based aerogels. Cryogels, on the other hand, were produced by freezing and freeze-drying the suspensions. The physical stability, content of soluble solids, and other relevant properties of the suspensions were investigated as a function of biomass and citric acid concentrations. Mild acidic treatment led to the solubilization of mainly pectic polysaccharides that acted as a continuous phase for the insoluble fibers and were responsible for the formation of the porous network after drying. Low-density (0.09-0.13 g/cm^3) porous materials boasting different morphologies and properties were obtained depending on the drying procedure and biomass fraction.
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