Pressurized Fluid Processes for Biorefinery and Production of High-value Added Products from Biomass

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Abstract

Enormous amounts of by-products from the Agri-Food industry are generated worldwide yearly, which have increased the demand for technologies that are harmless to the human being and protective of the environment. Technologies that use pressurized fluids such as subcritical water (sCW), pressurized ethanol and supercritical CO_2 (SC-CO_2) are considered "green" and environmentally friendly solvents. Research in my laboratory has intensified on the use of these pressurized fluids with various unit operations, including extraction, fractionation, adsorption, reaction and particle formation to obtain value-added compounds from a variety of food and agricultural by-products.

In this presentation, some examples of high value-added compounds obtained after processing with pressurized fluids will be demonstrated and discussed. Among the value-added compounds obtained are bioactives (phenolic acids, anthocyanins, amino acids, etc.) and biopolymers (chitosan, oligosaccharides, cellulose nanofibers, etc.). In one of the examples, a two-step sequential approach was evaluated based on subcritical water technology and the use of citric and malic acids to first extract and purify pea soluble polysaccharides from pea fiber, a co-product from the food industry, and then convert them to pectic oligosaccharides.

In other example, high value-added compounds were obtained after sCW processing followed by SC-CO_2 drying. First, subcritical water technology was used to treat various agricultural by-products to obtain hemicellulosic sugars and phenolic compounds, and a residue rich in cellulose and lignin. Then, the obtained cellulose residue was converted to cellulose nanofibers. These nanofibers were used to produce cellulose nanofiber hydrogels, and SC-CO_2 drying was used to obtain cellulose nanofiber aerogels. Other examples of high value-added compounds obtained after processing with sCW followed by SC-CO_2 will be provided.

In addition, examples using the biorefinery concept in the processing of crops aiming the production of new functional products and high value-added co-products will be discussed. Some biorefinery models from the integration and intensification of processes using clean emerging technologies such as pressurized fluid processing, and high-intensity ultrasound will be presented. For example, we have treated shrimp shells using sCW processing assisted by ultrasound to obtain value-added compounds such as chitin, chitosan and amino acids that can be further use in several applications for the food, pharmaceutical and biomedical sectors.

Overall, intensification and integration of these emerging processes aiming at the full use of Agri-Food by-products to generate value-added compounds based on the concept of biorefinery have been investigated. The results have shown that pressurized fluids with various unit operations can be used for a variety of applications.

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