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Valorization of Sargassum: Use of Twin-Screw Extrusion to Produce Biomolecules and Biomaterials

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Abstract : Sargassum is a brown algae, originally found in the Sargasso Sea, located in the Caribbean region and the Gulf of Mexico. The flow of Sargassum is becoming a critical environmental problem all over the Caribbean islands particularly. In Guadeloupe alone, around 80,000 tons of seaweed are stranded during the season. Since the appearance of the first waves of Sargassum algae, several measures have been taken to collect them to keep the beaches clean. Nevertheless, 90% of the collected algae are currently stored without recovery. The lack of research initiative demands a more in-depth exploration of Sargassum algae chemistry, targeted towards added value applications and their development. In this context, the aim of the study was to develop a biorefinery process to valorize Sargassum as a source of bioactive natural substances and as raw material to produce biomaterials simultaneously. The technology used was the twin-screw extrusion, which allows to achieve continuously in the same machine different unit fractionation operations. After the identification of the molecules of interest in Sargassum algae, different operating conditions of thermo-mechanical treatment were applied in a twin-screw extruder. The nature of the solvent, the configuration of the extruder, the screw profile, and the temperature profile were studied in order to fractionate the algal biomass and to allow the recovery of a bioactive liquid fraction of interest and a solid residue suitable for the production of biomaterials. Each bioactive liquid fraction was characterized and strategic ways of adding value were proposed. In parallel, the possibility of using the solid residue to produce biomaterials was studied by setting up Dynamic Vapour Sorption (DVS) and basic Pressure-Volume-Temperature (PVT) analyses. The solid residue was molded by compression cooking. The obtained materials were finally characterized mechanically. The results obtained were very comforting and gave some perspectives to find an interesting valorization for the Sargassum algae.

Keywords : seaweeds, twin-screw extrusion, fractionation, bioactive compounds, biomaterials, biomass
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