ANTIOXIDANT ACTIVITY OF LIQUID PHASE GENERATED DURING WOOD-BIOMASS HYDROTHERMAL TREATMENT

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Abstract

There is a strong need to offer renewable alternatives for products heavily relying on fossil resources, contributing to a more sustainable economy and society. Biomass is a valuable feedstock of wide range renewable carbon-based products; its conversion paths must be carefully chosen in order to enable technologically feasible and cost-effective solution. One of the very rapid and efficient method to convert biomass into different multifunctional products is hydrothermal carbonization (HTC). HTC is a process of biomass conversion into solid product (hydrochar), bio-liquid (potentially a source of various valuable chemicals) and gaseous (combustible) product, utilizing the water in subcritical state (at 200-300°C). The liquid phase that separates after the production of hydrochar has a high content of organic matter that originates from the treated plant material. The liquid phase is usually rich in polyphenols, flavonoids, anthocyanins, sugars, amino acids, as well as the breakdown products of ligno-cellulosic materials. It is known that these compounds exhibit different bioactive properties; therefore the liquid phase after hydrothermal treatment has potential antioxidant properties. The composition and properties of the liquid phase largely depend on the starting biomass and on the reaction conditions of the process, and can be widely used in the agronomic, chemical, and pharmaceutical industries. The aim of this research is to examine the content of total polyphenols in the liquid phase after the hydrothermal carbonization under different reaction conditions and to determine its antioxidant activity. Additionally, the qualitative characterization of volatile compounds in the liquid phase was performed by gas chromatography coupled to mass spectrometry (GC/MS). The liquid phase was collected after HTC treatment of waste wood-derived biomass under different reaction conditions: temperature (200-300°C), autogeneous pressure (1.5-8.7 MPa) and reaction time (30-165 min). The liquid phase samples have high polyphenol content, which was influenced by the reaction conditions of the hydrothermal process, and was in the range 0.37-0.98 g GA/L. The highest polyphenol content was recorded in samples obtained at the temperature of 300°C. Also, the samples showed a high antiradical potential (according to DPPH assay), which is connected with the high polyphenolic content. Liquid fractions, in the concentration of 2 mg/mL, exhibited antioxidant activity in the range of 61.4-87.0% against DPPH free radical. In the liquid samples phenol and their derivatives dominated, which were formed as a consequence of lignin degradation. The performed analysis of the liquid phase obtained in the hydrothermal carbonization of wood-based biomass showed that such product is rich in bioactive components, particularly those with antioxidant capacities, proving its high potential for applicability against oxidative stress.

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