

# HYDROTHERMAL CARBONIZATION OF WASTE WOOD BIOMASS: CHARACTERIZATION OF ANTIOXIDANT AND SAFETY ASPECT OF THE LIQUID PRODUCT

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## ABSTRACT

Hydrothermal carbonization (HTC) is a thermochemical process that enables valorization of waste biomass. Under relatively mild conditions (200-400°C and 4-25 MPa), HTC converts biomass material into a carbonaceous solid product (hydrochar), liquid phase and a small quantity of gases as primary products of reaction. The liquid (aqueous) phase is rich in organic compounds (polyphenols, flavonoides, etc.) and it could be used as a source of valuable biochemicals. In contrast, discharge of this water without its prior processing is hazardous for aquatic ecosystems due to high organic load. This study explores the antioxidant potential of liquid phases formed during HTC of wood-waste biomass under different conditions: temperature (200-300°C), autogenous pressure (1.5-8.7 MPa) and reaction time (30-165 min). At the same time, the contents of 16 EPA priority polycyclic aromatic hydrocarbons (PAHs) in the same liquid samples were determined in order to investigate influence of the reaction conditions.

The total polyphenol content and antioxidant activity of produced liquid phases were determined by standard spectrometric methods. The PAHs content was analysed by gas chromatography–mass spectrometry (GC/MS) after the liquid-liquid extraction with dichloromethane and solid-phase (silica gel) extraction clean-up. The liquid HTC samples (2 mg/ml of dry extract in methanol) have high polyphenols content (0.396-0.836 g Gallic acid/L) and showed a high antiradical potential (61-87% against DPPH free radical). The 2- to 4-ring PAHs dominated, generally in the following order of decreasing contents: naphthalene (111-164 µg/kg) > phenanthrene > fluoranthene ~ pyrene. The total 16 EPA PAHs concentration was in the range 50.5-374 µg/kg, with higher concentrations obtained at increased reaction temperature and duration. Naphthalene (low molecular 2-ring PAH with the highest water solubility among the 16 EPA PAHs) was found only in samples from the HTC tests conducted at temperatures above 200 °C and during the longest reaction time of 165 min. High molecular PAHs (with 5 and more rings in the molecular structure) were not detected and it might be hypothesized that this is the result of mild reaction temperature and/or the condensation of these higher PAHs onto the surface of hydrochar particles during the HTC reactor cooling.

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