FROM BIOMASS OF POPLAR UTILIZATIONS TO BYPRODUCTS

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Introduction

According to recent bioeconomy programs, chemical compounds derived from natural sources will be more available in regions where these compounds can be obtained economically than more expensive synthetic chemicals. In addition, the biorefinery is becoming an important aspect for green chemistry development aimed at ensuring the necessity to achieve the best objectives as favourable as possible from restricted natural resources such as forest biomass. One of the main scope is to generate diversified, innovative and renewable products using on-site bioresources such as wood and tree residues. Poplar tree species, including all their huge varieties, are largely cultivated in the world as a fast growing bioenergy crop. However the enormous potential of this trees in the field of biobased chemicals is still under-evaluated. The aim of this study was to verify the influence of thermo treatment at 180, 200 and 220 °C on wood extracts obtained via three different extraction techniques.

Thermo-vacuum system

Extractor
Solvent: EtOH-H_2O

Poplar extract

Material and Methods

Thermal treatment

Poplar materials were cut from logs and thermally modified at different temperature into a vacuum plant, developed by WDE Maspell srl (Terni, Italy).

- untreated controls (C)
- 180 °C (T180)
- 200 °C (T200)
- 220 °C (T220)

Extraction

Three different solid/liquid extraction techniques:

- Maceration extraction (ME)
- Ultrasound assisted extraction (UAE)
- Accelerated solvent extraction (ASE)

Solvent: mixture of ethanol:water (v/v)

Determination of antioxidant compounds

- Total polyphenol content (TPC) by using the Folin–Ciocalteu reagent
- Total flavonoid content (TFC) by using the aluminium chloride ($AlCl_3$)
- Total tannin content (TTC) by using the bovine serum albumin solution (BSA)

Evaluation of antioxidant activity

Radical scavenging ability by using the stable radical 2,2-diphenyl-1-picrylhydrazyl (DPPH)

Ferric reducing antioxidant power (FRAP)

Lipid peroxidation (BCB)

The chemical characterization of Poplar extractives by Gas chromatography-mass spectrometry (GC-MS) was performed.

Results

Different extractive yields (Fig. 1) of poplar components by using three different extraction techniques were obtained. The thermal treatment process mainly produced polar compounds. An important increase in polar compounds in poplar wood extractives was observed between 200° and 220 °C. Poplar extractives obtained after thermal treatment at 220 °C showed the highest RACI value (Fig. 2). This result confirms that high temperature of thermal treatment increases the antioxidant activity.

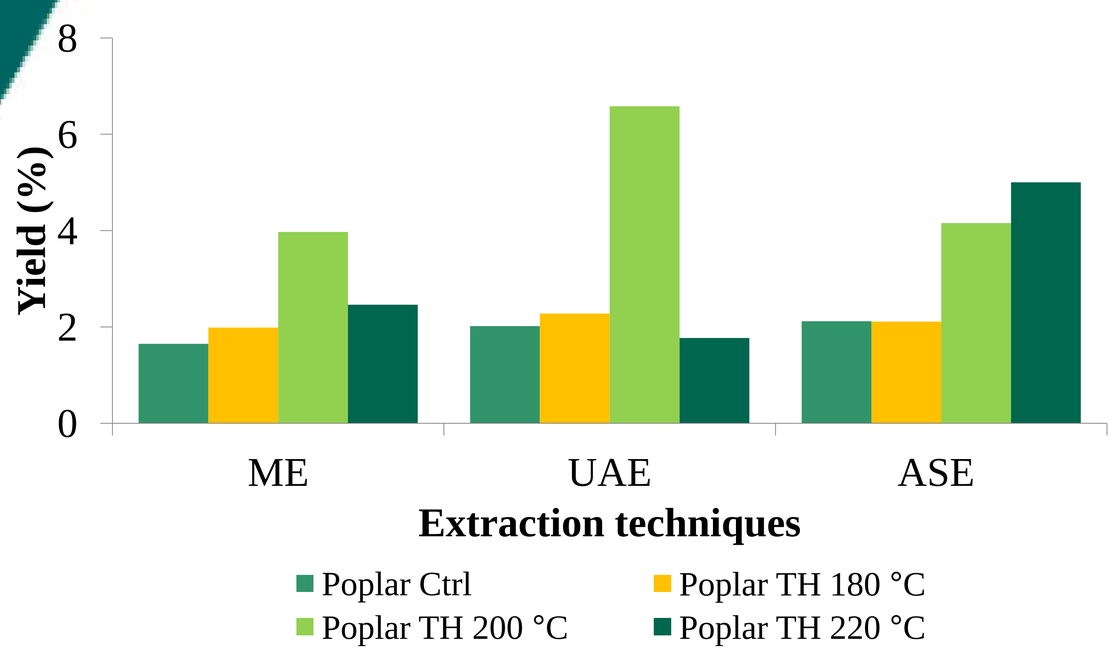

Figure 1. Yields (%) of untreated and thermo-treated poplar compounds obtained by using various extraction techniques.

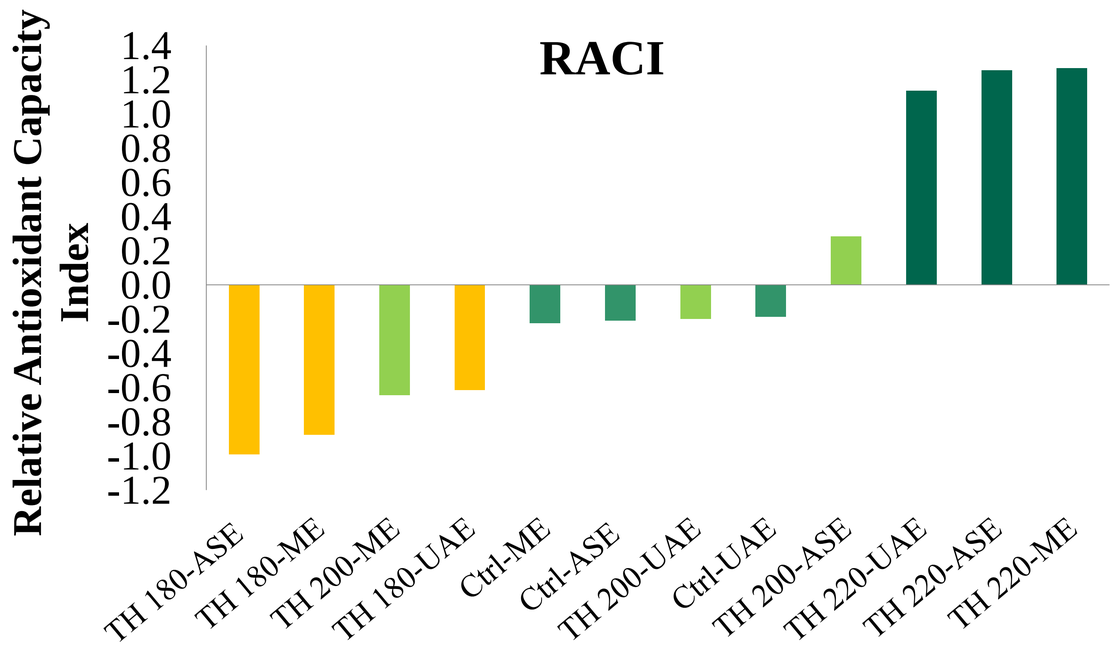

Figure 2. Relative antioxidant capacity index (RACI) values of wood extracts after extraction by different methods.

Conclusions

Recovery of woody material could provide a sustainable and environmentally friendly means for obtaining natural chemical components suitable for various industrial applications. The thermal process produced mainly polar compounds, particularly for poplar biomass subjected to temperatures between 200 and 220 °C. The study can be considered the first report on the higher antioxidant capacity of extracts derived from thermo-vacuum treated wood. Further investigations should be performed on poplar extracts to determine their potential applications as energetic, food supplements, nutraceuticals and health promoting natural compounds.

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