Comparative analysis of antioxidant extractives in the bark tissues of selected wood species

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ABSTRACT

The bark of forest trees is mostly regarded as a by-product of wood processing. However, both the inner- and outer bark tissues can be a rich resource of a wide range of extractives exhibiting several beneficial effects on human health (anti-inflammatory, anti-allergic, anti-cancerogenic, etc.). It has been proven that most of these effects are based on the antioxidant properties of these extractives. Antioxidants neutralize dangerous free radicals which are produced during biotic and abiotic stress processes, thus play a major role in the defence reactions and protection of the cells in living tissues.

By extracting these compounds from the bark they could possibly be used for several different industrial purposes (wood protection agents, conservants, health-care products, nutrition supplements etc.).

The present study aims at the extraction and assessment of antioxidant compounds from the bark tissues of selected industrial wood species. Following species were considered: Pine (*Pinus sylvestris*), White poplar (*Populus alba*), Black locust (*Robinia pseudoacacia*), Sessile Oak (*Quercus petraea*). Inner and outer bark tissues were separately collected and analysed. Tissues were investigated with and without microwave pre-treatment (700 Watt, 2 min for 500 g sample), which inactivates those enzymes in the tissues which can be responsible for the oxidation of polyphenols, thus the conservation of antioxidant compounds could be achieved. Respective bark tissues were ground and sieved. The fraction between 0.2-0.63 mm mesh was used for extraction. Extraction was carried out by sonication (2x10 min, with 0.15g bark sample + 15 ml solvent). Two extraction solvents were considered for the extraction procedure: water and 4:1 methanol: water. The following parameters were measured and evaluated: total extractive content, total phenol content (Folin-Ciocalteau method), antioxidant capacity (ABTS method). All measurements were run in triplicates. Measurement results are summarized in Table 1. The following conclusions have been established:

- The outer bark of the investigated species is usually more abundant in antioxidant compounds.
- The 4:1 methanol: water mixture proved to be more efficient for the extraction especially in the case of the outer bark.
- The samples containing the highest amounts of total extractives did not always show the highest concentration of polyphenols especially in inner bark, as these tissues can contain large amounts of other types of extractives too (e.g. sugars).

- The highest total phenol and antioxidant capacity values were determined for oak and poplar.
- From total phenol and ABTS antioxidant capacity values the PAC (phenol antioxidant coefficient, calculated as the ratio ABTS (mg/g) / total phenolics (mg/g)) value can be calculated, which indicates the antioxidant efficiency of phenolic extractives in the tissues. The highest PAC values were determined for the methanolic extract of the inner bark of poplar (6.52), indicating that the extractives in these tissues are very powerful types of antioxidants. The aqueous and methanolic extracts of the microwave treated inner bark of pine (5.40, 4.80) as well as some of the black locust samples also had high PAC values (6.51 and 3.80).
- The enzyme inactivating effect of the microwave pre-treatment was not always beneficial: except for oak in all of the samples total phenol and antioxidant capacity values decreased by the use of microwave pre-treatment. Microwave pre-treatment also had diverse influence on the PAC values.

Table 1: Results of the measurements

		Total extractives [%]		Total phenols [mg quercetin/g d.w]		ABTS [mg trolox/g d.w.]		PAC [ABTS/TP]	
Species	**Tissue**	**H_2O**	**4:1 MeOH: H_2O**	**H_2O**	**4:1 MeOH: H_2O**	**H_2O**	**4:1 MeOH: H_2O**	**H_2O**	**4:1 MeOH: H_2O**
Black locust (mw)	O.b.	4.40	6.70	7.84	18.47	19.62	70.13	2.50	**3.80**
Black locust (contr.)	O.b.	6.86	7.36	12.18	29.36	29.13	**103.32**	2.39	3.52
Oak (mw)	O.b.	8.38	9.38	26.60	36.85	76.54	**121.68**	2.88	3.30
Oak (control)	O.b.	6.91	8.89	25.30	**71.57**	61.53	86.49	2.43	1.21
Pine (mw)	O.b.	4.05	8.06	8.10	15.49	22.15	50.60	2.73	3.27
Pine (control)	O.b.	2.68	6.51	6.46	16.96	19.47	37.53	3.01	2.21
Poplar (mw)	O.b.	12.09	**17.24**	28.76	**54.78**	69.12	**179.33**	2.40	3.27
Poplar (control)	O.b.	10.93	**14.90**	27.25	**49.21**	59.74	**153.85**	2.19	3.13
Black locust (mw)	I.b.	10.42	9.20	3.04	3.22	9.79	11.31	3.22	3.52
Black locust (contr.)	I.b.	11.98	**12.86**	16.36	9.90	35.62	64.38	2.18	**6.51**
Oak (mw)	I.b.	8.36	9.91	16.64	19.73	40.96	70.22	2.46	3.56
Oak (control)	I.b.	9.59	**12.48**	33.82	**46.19**	95.00	**136.50**	2.81	2.96
Pine (mw)	I.b.	2.49	4.66	0.73	2.09	3.95	10.12	**5.40**	**4.84**
Pine (control)	I.b.	9.80	12.32	10.27	16.36	17.31	53.57	1.69	3.27
Poplar (mw)	I.b.	11.90	**13.57**	7.40	4.13	15.30	26.95	2.07	**6.52**
Poplar (control)	I.b.	11.60	**17.00**	31.29	**44.05**	98.63	**148.00**	3.15	3.36

I.b.: inner bark, O.b.: outer bark, mw: using microwave pre-treatment, control: without microwave pre-treatment.

Future investigations need to be carried out for the utilization possibilities of the extracts in fields of wood-, food- and pharmaceutical industry applications and also on bark tissues of other industrially important wood species. Future analyses should also aim at optimizing bark pre-treatment before extraction.

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