8TH HARDWOOD CONFERENCE

WITH SPECIAL FOCUS ON "NEW ASPECTS OF HARDWOOD UTILIZATION - FROM SCIENCE TO TECHNOLOGY"

HARDWOOD CONFERENCE PROCEEDINGS

VOLUME 8

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Complex assessment of the antioxidant capacity and polyphenol content of wood bark

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ABSTRACT

The investigation of antioxidant properties and polyphenol content of fruits, vegetables and of other plant tissues have already been the subject of numerous studies (e.g. Shui and Leong, 2004; Chan et al., 2011), yet the by-products of forest trees which are barely utilizable (e.g. bark, knots, leaves, cones, root) can also contain antioxidant polyphenols in high concentrations (Lesjak et al., 2011; Sathya and Siddhuraju, 2012), making these by-products possible raw materials for antioxidant extraction and utilization.

The present research focuses on the assessment of the antioxidant capacity and polyphenol content of the bark of 11 selected wood species by the combined evaluation of different methods. Species involved black locust, sessile oak, Scots pine, white poplar, E. beech, E. hornbeam, black cherry, sweet chestnut, black poplar, silver birch and E. larch: these species are either important Hungarian industrial wood species yielding large amounts of bark by-products or species which have not been investigated yet.

Apart from E. hornbeam and E. beech the inner and outer bark were both investigated. Bark samples were extracted by ultrasonication using methanol:water 20:80 v/v% solution. Antioxidant capacity was determined using the DPPH- (2,2-diphenyl-1-picrylhydrazyl), FRAP- (ferric reducing ability of plasma) and ABTS- (2,2′-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) assays. Polyphenolic composition was measured by the Folin-Ciocâlteu method (total polyphenol content), by the total flavonoid assay and by the total flavan-3-ol assay.

As a rule of thumb, at least three antioxidant capacity assays should be run to assess the antioxidant properties of plant extracts, as none of the currently applied methods are suitable alone to determine the overall antioxidant capacity. This is, because each assay is specific to certain types of antioxidants, thus none of the methods sufficient to measure the overall antioxidant power of all compounds found in a plant extract. Because of the different selectivity of each method, information on the overall antioxidant power of the samples or of individual compounds can be obtained only by the combined evaluation of different assays (Hofmann et al. 2017). This was achieved in the present work by introducing a scoring system which combines the results of the DPPH, FRAP and ABTS antioxidant assays. This combined multiassay approach (CMA) was set up as follows: samples were ordered according their antioxidant capacity value within each assay, then score 1 was assigned to the highest antioxidant capacity and score 0 was given to the lowest antioxidant capacity sample, within one assay; to the samples with intermediate antioxidant capacity values scores were assigned proportionally in the range [1;0]. Finally, scores were summed for each sample. Theoretic maximum score was 3 (when sample has the highest antioxidant capacity with all of the 3 methods). Table 1. indicates the scores as well the results on polyphenolic composition.

Table 1. Left: Evaluation of the antioxidant capacity of the samples basing on a scoring system, combining the results of the DPPH, FRAP and ABTS assays sample-wise. Maximum score: 3. Right: Total polyphenol, flavonoid and flavan-3-ol contents of the samples. -: not detected, Q: quercetin, C: (+)-catechin.

Species	Inner bark	Outer bark	Total polyphenols (mg Q/g d.w.)		Total flavonoids (mg Q/g d.w.)		Total flavan-3-ols (mg C/ g d.w.)	
			Inner bark	Outer bark	Inner bark	Outer bark	Inner bark	Outer bark
Black locust	0.79	1.15	9.90	29.4	-	-	-	-
Sessile oak	1.57	1.28	46.2	71.6	-	-	-	-
Scots pine	1.66	0.80	76.2	16.4	-	0.42	21.6	3.05
White poplar	1.36	1.46	44.1	49.2	-	-	-	-
European beach	1.33	-	42.7	42.7	-	-	-	-
European hornbeam	1.24	1.24	25.2	25.2	0.39	1.48	0.39	0.39
Black cherry	2.92	1.43	139.0	70.0	3.71	2.49	61.8	19.5
Sweet chestnut	2.22	2.55	61.4	89.0	1.30	4.81	2.48	0.77
Black poplar	0.16	0.63	36.3	52.8	0.74	1.92	1.60	1.42
Silver birch	1.72	1.21	76.6	57.3	-	-	14.7	8.88
European larch	2.22	2.15	107	121	-	-	32.0	20.0

According to the CMA evaluation the samples with the highest overall antioxidant capacity were the inner bark of black cherry and the outer bark of sweet chestnut. The inner bark of cherry contains large amounts of flavan-3-ol type compounds, possibly responsible for the strong antioxidant effects. In the outer bark of sweet chestnut it is not the flavonoid and flavan-3-ols but possibly other types of polyphenols (e.g. tannins) which are responsible for the excellent antioxidant properties. According to the results, the presented CMA evaluation is suitable for tracking complex antioxidant properties in wood bark, and can be also applied to other tissues such as cones or leaves. Samples with highest values need further evaluations for possible uses in the future.

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