

## Phytochemical characterization of leaf and root tissues from raspberry, including antioxidant activity evaluation

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**Abstract.** In raspberry, the fruit is the only part of the plant consumed and berries are well known sources of antioxidants with recognized health benefits (brain function protection, cancer prevention, diabetes, obesity and cardiovascular diseases prevention and plasma cholesterol decrease). However, other tissues of the same plant may well be regarded as potential sources of new and active polyphenols. The aim of this work was to evaluate the polyphenol content and antioxidant activity of fruits, leaves and roots of *Rubus idaeus* cv. Polka, to assess the potential of its leaves and roots as sources of polyphenols.

The tissue extracts obtained using a clean method with an hydroethanolic solvent were analysed for total polyphenol and flavonoid content, HPLC polyphenol profile and peroxyl radical scavenging activity determined by the ORAC method.

Leaves were the tissues with a higher polyphenol content (38.1 mg GAE g<sup>-1</sup> dw), followed by roots and then by fruits. However, flavonoid content in roots (15.48 mg (+) catechin g<sup>-1</sup> dw) was significantly higher than of leaves and fruits. Although the three tissues contain different polyphenol and flavonoid contents, the peroxyl radical scavenging activity of all tissues presented statistically similar values. The antioxidant capacity detected for fruits and leaves was particularly high when compared with the values reported in the literature for other berry crops.

The HPLC profiles detected at 280 nm for the three tissue extracts are quite different. The electrochemical detection of the same profile indicates that some compounds present in root and leaf tissues show potential antioxidant activity. With this work, we demonstrate that leaf and root tissues possess an antioxidant activity as high as the fruit tissue, but contain different compounds. Therefore, *R. idaeus* leaf and root tissues show a promising potential for application in food, cosmetic, pharmaceutical and/or nutraceutical industries.

**Introduction.** Raspberries are well known sources of antioxidants with recognized health benefits. However, in raspberry production only the fruits are profitable. Some studies have been performed for different berry cultivars in many environments, comparing polyphenols and antioxidant activity of fruits and in some cases leaves. In Portugal, one of the cultivars used in raspberry production is “Polka” and the only plant tissue used are fruits. However, other tissues of the plant may well be regarded as potential sources of new and active polyphenols and as profitable tissues. The aim of this work was to evaluate the polyphenol content and antioxidant activity of fruits, leaves and roots of *Rubus idaeus* cv. Polka, to assess the potential of its leaves and roots as new sources of polyphenols.

**Materials and Methods.** For each tissue (fruit, leaf and root) an extraction with water/ethanol mixture 1:1 (6 mL.g<sup>-1</sup>) was performed. The homogenate was incubated for 30 min with shaking. Then, the mixture was centrifuged and filtered. The extracts were stored at -80 °C, under nitrogen atmosphere. Determination of total phenolic compounds was performed by Folin-Ciocalteu method [1]. Gallic acid was used as standard, and results were expressed as milligrams of equivalents gallic acid per gram dry weight (mg GAE g<sup>-1</sup> dw). Determination of flavonoid content was performed by adaptation of AlCl<sub>3</sub> complexation method [2]. Catechin hydrate was used as a standard, and the results were expressed as mg catechin equivalents g<sup>-1</sup> dw (mg CE g<sup>-1</sup> dw) of plant material. Peroxyl radical scavenging capacity was determined by ORAC (Oxygen Radical Absorbance Capacity) method [3, 4].

Results were expressed as  $\mu\text{mol}$  6-hydroxy-2,5,7,8-tetramethylchroman-2-carboxylic acid (Trolox) equivalents  $\text{g}^{-1}$  dw ( $\mu\text{mol TE g}^{-1}$  dw). Analyses by HPLC were performed as described previously [5].

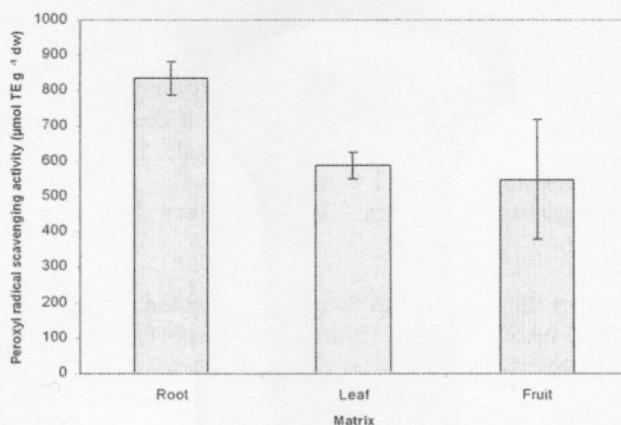


Fig. 1- Peroxyl radical scavenging activity for leaf, root and fruit of *R. idaeus* cv. Polka

**Results and Discussion.** Leaves were the tissues with a higher polyphenol content ( $38.1 \text{ mg GAE g}^{-1}$  dw), followed by roots and then by fruits ( $26$  and  $12.2 \text{ mg GAE g}^{-1}$  dw respectively). However, flavonoid content in roots ( $15.48 \text{ mg (+) catechin g}^{-1}$  dw) was significantly higher than those of leaves and fruits ( $13.18$  and  $1.73 \text{ mg (+) catechin g}^{-1}$  dw respectively). Although the three tissues contain different polyphenol and flavonoid contents, the peroxyl radical scavenging activity of all tissues presented similar values ( $835$ ,  $588$  and  $548 \mu\text{mol TE g}^{-1}$  dw for root, leaf and fruit) (Fig. 1).

The HPLC profiles detected at  $280 \text{ nm}$  for the three tissue extracts are quite different, showing some peaks in common. The high antioxidant activity observed *in vitro* for the root tissue and the presence of few and not so elevated HPLC peaks seems to point out a very promising matrix (Fig. 2).

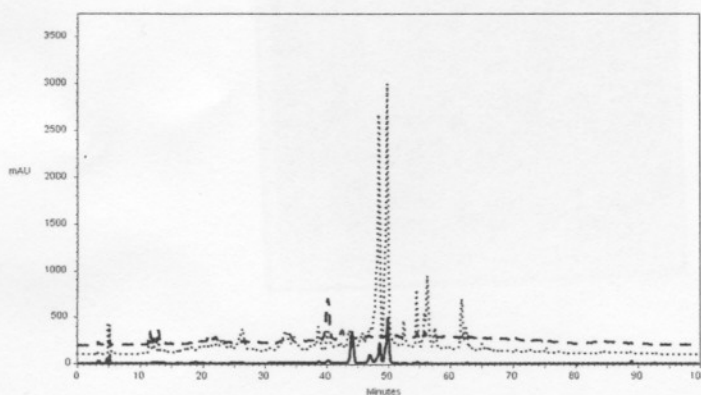


Fig. 2- HPLC chromatogram at  $280 \text{ nm}$  for leaf, root and fruit of *R. idaeus* cv. Polka. Legend --- root, +++ leaf, \_\_\_ fruit.

The electrochemical detection of the same profiles indicates that some compounds present in root and leaf tissues show potential antioxidant activities, corroborating the previous results. Therefore, leaf and root seem to be promising tissues with potential for application in industries where antioxidant capacity is primordial like food, cosmetic, pharmaceutical and/or nutraceutical industries. However, further HPLC determination and *in vivo* studies will be performed to determine which compounds are present in leaf and root, for a better assessment of their potential.

## References

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