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## NON-DESTRUCTIVE ANALYSIS OF THE CONTENT OF ANTHOCYANINS AND FLAVONOIDS IN PLANTS

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### ABSTRACT

The levels of flavonoids and anthocyanins at the 38 selected plant species was measured using the spectrophotometric method with the help of Multiplex – 3 apparatus. The samples of plant material were taken in July and August 2012 at the Botanical and demonstration garden in the area of SPU in Nitra. A special place is taken by common wheat spring form (*Triticum aestivum*) and its 5 varieties (*Katya*, *Aranka*, *Saxana*, *Prelom*, *Korzo*) - these plants were grown under controlled conditions in climabox and the measurement was done in March. The findings were compared with each other and graphically depicted. The results of measuring proved that blackberry (*Rubus fruticosus*) has the highest content of flavonoids, and red currants (*Ribes rubrum*) have highest content of anthocyanins. Based on the results, it is possible to emphasize the importance of fruit and vegetables consumption that are rich in these health benefit substances.

**Key words:** antioxidants, anthocyanins, flavonoids

**Acknowledgments:** The results in paper are the outcome of the my thesis, which was done within the engineering studies at the Faculty of Agrobiolgy and Food Resources in Nitra, at the Department of Plant Physiology. “Non - destructive analysis of the content of anthocyanins and flavonoids in plants”.

## INTRODUCTION

Flavonoids are a very rich group of plant phenolics. They help plants to react on environmental changes. Flavonoids are present in plants in all of their parts: in flowers, leaves, fruits and in seeds (Cook, Samman, 1996). The main sources of flavonoids in human food are mostly vegetables, fruit and drinks as wine and tea (De Groot, Rau, 1998). Flavonoids have its importance in human nutrition as well. Higher consumption of them can help in prevention against tumor and cardiovascular diseases. Diverse colors of small fruits are caused by the occurrence of anthocyanins and carotenoids. Anthocyanins are highly present in fruits and vegetables mostly. Among the effects of anthocyanins are antibacterial effects, positive effect against aging, prevention against inflammation of the urinary tract, they have regenerative and preservative influence on vitamin E (Žoldošová, 2003).

The main aim of this contribution was to identify the amount of flavonoids and anthocyanins in selected species of plants.

## MATERIAL AND METHODS

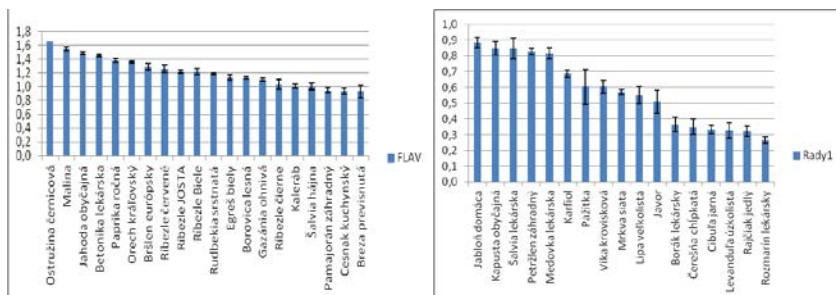
Multilplex-3 (Force-A, France) apparatus for non-destructive measuring of flavonoid and anthocyanin content was used. There was an experimental group of 38 species of plants (Tables 1 and 2). The samples of plant material were taken in July and August 2012 at the Botanical and demonstration garden in the area of SPU in Nitra. Five varieties (*Katya*, *Aranka*, *Saxana*, *Prelom*, *Korzo*) of common wheat (*Triticum aestivum*) were grown under controlled conditions in climabox Snijders - model MC1750VHOE-EVD and the measuring was done in March. The monitored parts of all the plants were leaves. Differences among plant species in the content of substances evaluated were graphically illustrated using confidence intervals.

## RESULT AND DISCUSSION

**Tab. 1** Flavonoids – list of evaluated plant species and number of measurements

| SPECIES                   | N*  | SPECIES                                | N*  | SPECIES                       | N*  |
|---------------------------|-----|--|-----|-------------------------------|-----|
| <i>Rubus fruticosus</i>   | 15  | <i>Betula pendula</i>                  | 44  | <i>Ribes nigrum</i>           | 30  |
| <i>Raspberry</i>          | 60  | <i>Malus domestica</i>                 | 30  | <i>Brassica</i>               | 31  |
| <i>Fragaria vesca</i>     | 146 | <i>Brassica oleracea</i>               | 15  | <i>Salvia nemorosa</i>        | 15  |
| <i>Medicina natura</i>    | 15  | <i>Salvia officinalis</i>              | 30  | <i>Origanum vulgare</i>       | 14  |
| <i>Capsicum annum</i>     | 135 | <i>Petroselinum crispum</i>            | 59  | <i>Allium sativum</i>         | 17  |
| <i>Juglans regia</i>      | 73  | <i>Melissa officinalis</i>             | 14  | <i>Allium cepa</i>            | 138 |
| <i>Euonymus europaeus</i> |     | <i>Brassica oleracea var. botrytis</i> | 14  | <i>Lavandula angustifolia</i> | 15  |
| <i>Ribes rubrum</i>       | 46  | <i>Allium schoenoprasum</i>            | 15  | <i>Solanum lycopersicum</i>   | 15  |
| <i>Ribes JOSTA</i>        | 15  | <i>Vicia desertorum</i>                | 14  | <i>Rosmarinus officinalis</i> | 15  |
| <i>Ribes sativa</i>       | 89  | <i>Daucus carota</i>                   | 223 |                               |     |
| <i>Rudbeckia hirta</i>    | 15  | <i>Tilia platyphyllos</i>              | 43  |                               |     |
| <i>Grossularia albus</i>  | 89  | <i>Acer</i>                            | 44  |                               |     |
| <i>Pinus sylvestris</i>   | 34  | <i>Borago officinalis</i>              | 14  |                               |     |
| <i>Gazania splendens</i>  | 15  | <i>Cerasus subhirtella</i>             | 45  |                               |     |

N\* (number of measurements)



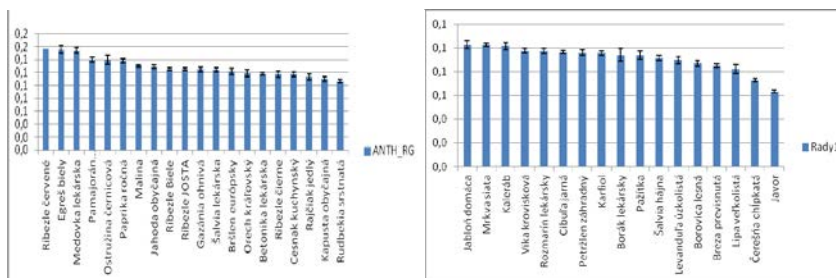
**Graph. 1** Content of flavonoids in plants

Graph 1 shows that the highest content of total flavonoids has *Rubus fruticosus*, the exact amount is 1.662 mg.kg<sup>-1</sup>. The lowest amount was detected in *Rosmarinus officinalis* 0.267 mg.kg<sup>-1</sup>.

**Tab. 2** Anthocyanins – list of evaluated plant species and number of measurements

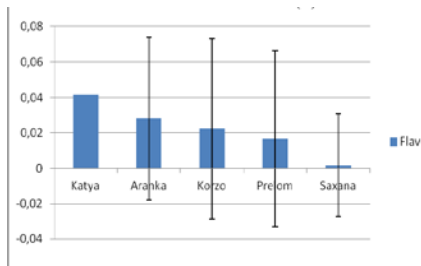
| SPECIES                   | N*  | SPECIES                                | N*  | SPECIES                       | N*  |
|---------------------------|-----|--|-----|-------------------------------|-----|
| <i>Rubus fruticosus</i>   | 15  | <i>Betula pendula</i>                  | 44  | <i>Ribes nigrum</i>           | 30  |
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| <i>Medicina natura</i>    | 15  | <i>Salvia officinalis</i>              | 30  | <i>Origanum vulgare</i>       | 14  |
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| <i>Juglans regia</i>      | 73  | <i>Melissa officinalis</i>             | 14  | <i>Allium cepa</i>            | 138 |
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| <i>Ribes rubrum</i>       | 46  | <i>Allium schoenoprasum</i>            | 15  | <i>Solanum lycopersicum</i>   | 15  |
| <i>Ribes JOSTA</i>        | 15  | <i>Vicia desertorum</i>                | 14  | <i>Rosmarinus officinalis</i> | 15  |
| <i>Ribes sativa</i>       | 89  | <i>Daucus carota</i>                   | 223 |                               |     |
| <i>Rudbeckia hirta</i>    | 15  | <i>Tilia platyphyllos</i>              | 43  |                               |     |
| <i>Grossularia albus</i>  | 89  | <i>Acer</i>                            | 44  |                               |     |
| <i>Pinus sylvestris</i>   | 34  | <i>Borago officinalis</i>              | 14  |                               |     |
| <i>Gazania splendens</i>  | 15  | <i>Cerasus subhirtella</i>             | 45  |                               |     |

N\* (number of measurements)



**Graph. 2** Content of anthocyanins in plants

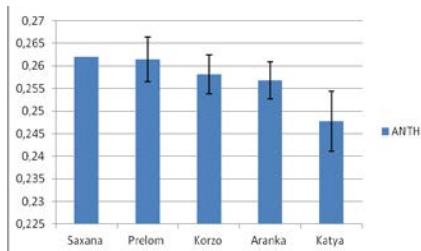
The values presented in graph 2 show that the highest amount of total content of anthocyanins we detected in *Ribes rubrum* with the amount of  $0.156 \text{ mg.kg}^{-1}$ . On the other hand, the lowest amount was found in woody plant *Acer* and its amount was  $0.063 \text{ mg.kg}^{-1}$ .



N\*=18 N\*(number of measurements)

Graph. 3 Content of flavonoids in individual varieties of common wheat spring form

The total content of flavonoids in the monitored varieties of *Triticum aestivum L.* ranged from  $0.002 \text{ mg.kg}^{-1}$  to  $0.042 \text{ mg.kg}^{-1}$  of the sample. According to the total content of flavonoids it is possible to set the following order: Katya > Aranka > Korzo > Prelom > Saxana (Graph 3).



N\*=18 N\*(number of measurements)

Graph. 4 Content of anthocyanins in individual varieties of common wheat spring form

The total content of anthocyanins in the monitored varieties of *Triticum aestivum L.* ranged from  $0.248 \text{ mg.kg}^{-1}$  to  $0.262 \text{ mg.kg}^{-1}$ . According to the total content of anthocyanins it is possible to set the following order: Saxana > Prelom > Korzo > Aranka > Katya (Graph 4).

Marinova et al. (2005) detected the amount  $160 \text{ mg.kg}^{-1}$  of total flavonoids in spring onions, while in tops the amount was  $117 \text{ mg.kg}^{-1}$  and in head only  $25 \text{ mg.kg}^{-1}$  which means that the source of flavonoids are mostly tops that many times are not consumed. Results from Giovanelli and Buratti (2009) ranged in strawberries from 4 to  $4.6 \text{ mg.kg}^{-1}$ . Da Silva Pinto et al. (2008) detected the amount of total flavonoids in strawberries  $2.94 \text{ mg.kg}^{-1}$ . Marinova et al. (2005) detected total flavonoids in raspberries on average  $17.86 \text{ mg.kg}^{-1}$  of fresh substance.

## CONCLUSIONS

The highest content of total flavonoids had *Rubus fruticosus* with an average amount of 1.662 mg.kg<sup>-1</sup> and on the other hand the lowest amount was observed in *Rosmarinus officinalis* 0.267 mg.kg<sup>-1</sup>. In the monitored varieties of *Triticum aestivum* L. the highest amount of flavonoids was observed in variety Katya with an average amount of 0.042 mg.kg<sup>-1</sup>, the lowest amount was in variety Saxana 0.002 mg.kg<sup>-1</sup>.

From the examined species the highest content of total anthocyanins had *Ribes rubrum* with an average amount of 0.156 mg.kg<sup>-1</sup> and the lowest amount showed woody plant *Acer* 0.063 mg.kg<sup>-1</sup>. In the monitored varieties of *Triticum aestivum* L. the highest amount of anthocyanins was detected in variety Saxana with an average amount of 0.262 mg.kg<sup>-1</sup>, the lowest was measured in variety Katya 0.248 mg.kg<sup>-1</sup>.

Based on the mentioned results we can emphasize the importance of fruit and vegetables consumption that are rich in these health benefit substances.

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