

## TOTAL PHENOLIC CONTENT, ANTIOXIDANT CAPACITY AND MINERAL CONTENT OF SELECTED FRUITS FROM NORTHEASTERN HUNGARY

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### Abstract

Fruits have been very essential in the growth and development of human life. Therefore, the present study was designed to evaluate the chemical composition of cherry, plum and pear cultivars grown in northeastern part of Hungary. Twelve fruit species were screened for their total phenolic content, antioxidant capacity and mineral content. The results show that the chemical composition and antioxidant capacity of the investigated fruits varies significantly. Total phenolic contents of the selected fruit cultivars (cherries, plums and pears) were investigated according to the method of Singleton and Rossi, while the antioxidant activity of the fruits was determined using the ferric reducing antioxidant power (FRAP) assay. Positive correlation was found between the total phenolic content and antioxidant activity that means the phenolic content of these fruits contributes to antioxidant capacity. Mineral contents varied greatly between the species. Cherry was found to be the richest source of minerals. The most abundant mineral detected was potassium, followed by calcium and phosphorus. The trace elements were detected in lower amounts. Results showed that these fruits contain considerable amounts of minerals and phenolics, resulting also in significant antioxidant activity. They strongly support the evidences that fruits promote health benefits. These fruits, especially cherries could be potential rich resources of natural antioxidants and could be developed into functional foods or drug for the prevention and treatment of diseases caused by oxidative stress.

### Introduction

Fruits have historically held a place in human diet because of their immense nutritional values. They are natural sources of beneficial components that play an important role in human nutrition and health. Fruits are particularly recognized as a source of vitamins, dietary fibre and other antioxidant compounds, such as phenolics, vitamins, carotenoids and minerals, which contribute to their chemo-preventive potential [1,2].

Phenolics are bioactive non-nutrient compounds that attribute to the sensory qualities (color, flavour, taste) of fresh fruits. In addition, many phenolic phytochemicals have antioxidative, anticarcinogenic, antimicrobial, antiallergic, antimutagenic and inflammatory activities [3,4]. Therefore, the role of fruits in disease prevention is partly associated with the antioxidant properties of their constituent phenolics [5,6]. Antioxidants are compounds that retard or inhibit the oxidation of molecules that can occur by the presence of reactive free radicals, thus protecting the body from several diseases [7]. Other health benefits of eating fruit are attributed to minerals, they are inorganic substances required by the organism in very small amount for maintenance of vital processes essential for life [8]. Epidemiological studies have found that the intake of fruits has a strong inverse correlation with the risk of developing many chronic diseases, such as cardiovascular diseases and cancer [9,10,11]. In this manner, the present research was designed to shade some light on the composition of plums, pears and

cherries grown in north-eastern part of Hungary. Particularly, mineral content, total phenols and the effect related to antioxidant capacity were determined.

## **Experimental**

### Sample collection

Fresh fruits were collected at commercial maturity during the 2017. harvest season (July, August and September). All samples originated from Szabolcs-Szatmár-Bereg country near Nyíregyháza city in north-eastern part of Hungary. From these fruits, 3 were cherry cultivars, 1 pear cultivar, and the rest were plum cultivars, respectively 8.

### Sample preparation

The whole edible part of the fruit was used in the study. The fruits were washed, then they were cut in halves and pits were removed. Samples were cut into small pieces, weighed accurately (~ 40 gram), and freeze-dried immediately, since chopped material is much more unstable and may result in enzymatic browning, as well as undesirable molecular, biochemical and physiological changes. After freeze drying the samples were weighed again to determine the dry matter without water. The 250 mg/10 ml solutions were centrifuged (6000 rpm, 20 min, 4 C°) and the clean supernatants were analysed.

### Determination of antioxidant capacities by FRAP (Ferric Reducing Antioxidant Power) method

Measurement of ferric reducing antioxidant power of the fruit extracts was carried out based on the procedure of Benzie and Strain [12], at 593 nm. (Spectronic Helios Gamma UV Visible Spectrophotometer Thermo Fisher Scientific.) Ascorbic Acid was used as a standard to prepare the calibration solutions. Results were expressed as  $\mu\text{MAA/g}$  of dry plant material.

### Determination of total phenolic contents by Folin-Ciocalteu method

The Folin - Ciocalteu method is an electron transfer based assay and gives reducing capacity which is expressed as phenolic content. Total phenolic content of the fruit extracts was determined with the Folin-Ciocalteu reagent according to a procedure described by Singleton and Rossi [13], at 760 nm.

Gallic acid was used to prepare the standard curve. The results were expressed as  $\text{mMGA/g}$  of dry plant material.

### Mineral content analysis using ICP-OES

The presence of the following minerals: Ca, Mg, K, Na, Fe, Cu, Zn, Mn and P was investigated by inductively coupled plasma optical emission spectrometry (ICP-OES). All the previously freeze-dried samples were prepared for the analysis via microwave digestion method by using concentrated nitric acid and hydrogen peroxide.

After mineralization, the resulting solutions were cooled to room temperature, then they were transferred to autosampler tubes and diluted to a final volume of 25 mL with Milli-Q water. The determination of mineral contents in this clear solution was carried out by ICP-OES. The concentrations of the calibration solutions were in the range from 1 to 100 mg/kg (1,5,10,100 mg/kg, respectively) to match the amount of the elements possibly present in the samples.

## Results and discussion

### Total Phenolic Content

The results from the study showed a variation of total phenolic (TP) contents between the fruits tested. The TP content ranged from  $13.87 \pm 0.18$  to  $76.60 \pm 9.23$  mMGA/g of dry weight. Among the fruits that were used in the study, the highest content of phenolics resulted from cherry cultivars, two to three times higher than the phenolic contents of plums and pear cultivars. The results showed that Oblacsinszka species (cherry cultivar), were the richest source of phenolics with a total phenolic content of  $76.60 \pm 9.23$  mMGA/g of dry weight. The lowest content of phenolics among all tested fruits was recorded for Vilmos species (pear cultivar), only  $13.87 \pm 0.18$  mMGA/g of dry weight. TP content of 8 plum samples shows variation, the highest TP content was found in Unknown C plum sample.

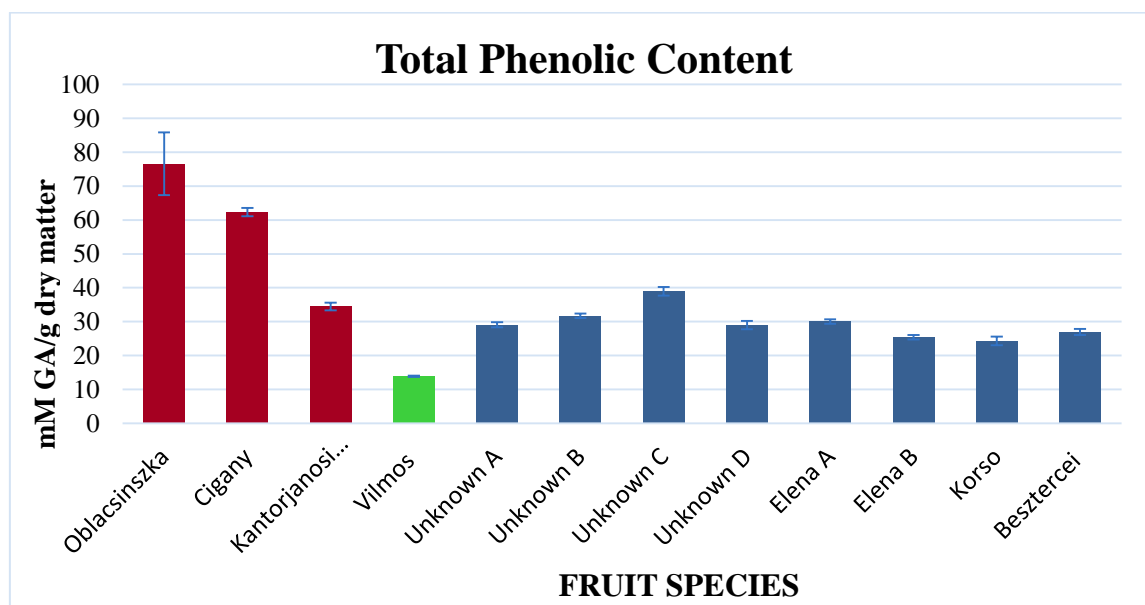


Figure 1. Total phenolic content of the investigated fruits

The total phenolic contents of the cherry species tested in the present study (118.72 – 233.01 mg GAE/100 g fw) were similar to those reported in the literature. The phenolic contents of sweet and sour cherries were investigated by Prvulovic et al. [14], the results showed that the lowest TPC was 76.05 while the highest was up to 301.19 mg gallic acid equivalents/100 g fresh fruit weight.

### Antioxidant Capacity

FRAP values of the tested fruits varied significantly among each other, starting from  $4.89 \pm 0.14$  to  $52.58 \pm 0.50$   $\mu$ MAA/g of dry weight. Cherry cultivars resulted to have the highest antioxidant capacity among the studied fruits, followed by plum cultivars and lastly, the pear cultivar.

In descending antioxidant activity, the order was: cherry > plum > pear.

### Correlation between Antioxidant Capacity and Total Phenolic Content

Despite the presence of a wide range of the antioxidant capacities and total phenolic contents among the selected fruits, the results showed a positive linear correlation between the antioxidant capacity and total phenolic content ( $R^2 = 0.9176$ ) Figure 2. Moreover, an increase in antioxidant capacity corresponds to the increase in the total phenolic content. These results

indicate that the phenolic compounds could be the main contributor of the antioxidant activities of these fruits. These results were in agreement with many previous studies [15].

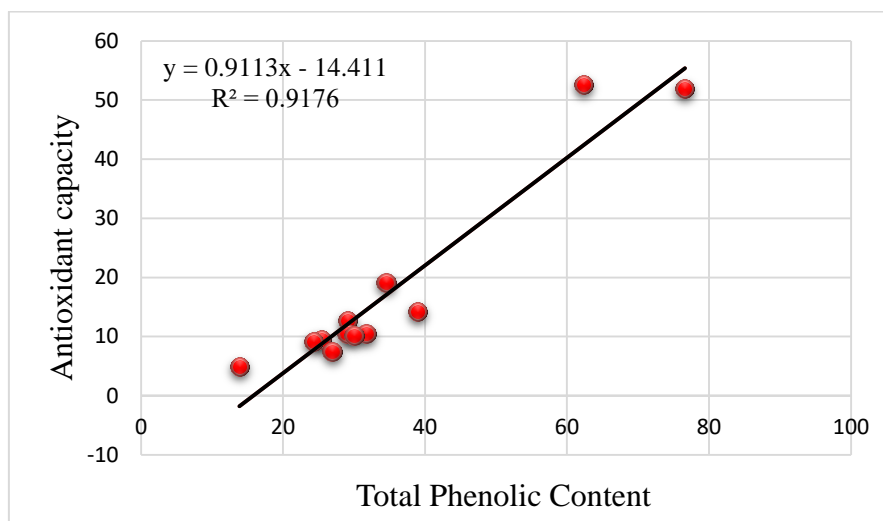


Figure 2. Correlation between the total phenolic content and antioxidant capacity of the selected fruits. Antioxidant capacity was measured by the FRAP assay and TPC by Folin-Ciocalteu method

#### Mineral contents

The concentrations of Na, K, Ca, Mg and P (major elements) as well as Fe, Mn, Cu and Zn (minor elements) were determined in 12 fruit samples using inductively coupled plasma optical-emission spectrometry (ICP-OES). The results are shown in table 1.

Fruit species	Concentration of minerals (mg/kg dry weight)								
	Ca	Cu	Fe	K	Mg	Mn	Na	P	Zn
Oblacsinszka	1520	11	17	14000	780	6.3	8.2	1300	3.5
Cigany	1500	13	15	13000	720	3.7	3.4	1500	4.5
Kantorjanosi Cigany	1200	4.6	11	12000	560	2.4	5.6	950	3.3
Vilmos	660	4.1	16	6400	270	2.1	11	450	4.2
Unknown A	690	3.5	7.5	9100	442	2.8	2.8	710	3.7
Unknown B	740	3.9	8	11100	430	2.6	7	740	3.9
Unknown C	540	4.7	49	11000	410	5.4	3.8	670	5.2
Unknown D	590	3.2	6.4	10000	390	3.1	5.3	715	4.2
Elena A	670	3.6	9.6	11300	490	4.1	3.6	980	4.9
Elena B	520	5.3	9	15000	470	5.6	2.6	970	5.8
Korso	560	3.7	9.4	12100	520	4.5	5	870	7.3
Besztercei	540	2.2	16	9000	340	2.3	1.6	720	3.4

Table 1. Mineral content of the investigated fruits (mg/kg dry weight)

The results listed in Table 10. shows that the most abundant mineral among the analysed fruit cultivars was potassium, followed by calcium, phosphorus and magnesium. Other microelements such as iron, manganese, zinc, copper and sodium were detected in much lower amounts.

## **Conclusion**

The chemical composition and antioxidant capacity of the investigated fruits varies significantly due to many factors (genetics, soil composition etc.). There was a positive correlation between the total phenolic content and antioxidant activity, showing that the phenolics from these fruits may supply substantial antioxidants, which gives health-promoting advantages to the consumer.

With this study we proved that these fruits are rich sources of potassium, cherries contain the highest concentrations of all the minerals, leaving behind plums and pears. It was reported that in general fruits are not good sources of calcium. In this study, it was found that some fruits contained significant amount of calcium. In general, the elemental concentration in all samples decreased in the following order: K > Ca > P > Mg > Fe > Na > Cu > Mn > Zn. The difference in the elemental concentration between the samples can be a result of variations in the geographic origin and cultivation conditions.

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