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# Effect of variety and cultivation technology on phenols and antioxidant activity of sweet and sour cherry

**Sass-Kiss[1], A., Tóth-Márkus[1], M., Daood[1], H.G., Bánáti[1], D., Nyéki[2], J. & Szabó[2], Z.**

*[1]Central Food Research Institute, Budapest, Hungary,*
*[2]University of Debrecen, Centre of Agricultural Sciences Institute for Research and Development*

***Summary:*** The goal of the present work was to compare different sweet and sour cherry cultivars and cultivation methods (bio/integrated) with respect to polyphenol content and antioxidant activity. The concentration of total polyphenols ranged between 880–1050 mg $kg^{-1}$ of fresh fruit, whereas antioxidant activity expressed as TEAC was found to be between 5.4 and 10.3 mmol $kg^{-1}$ for the sweet cherry cultivars examined. In case of sour cherry the level of polyphenols ranged between 1283 and 3490 mg/kg fresh edible part of the fruit. Antioxidant activity was recorded between 15–32 mmol $kg^{-1}$ for the different sour cherry cultivars included in this work. After one-month storage at low temperature, the total phenols and antioxidant activity decreased by 2–40% in the sour cherry cultivars studied. The anthocyanin content in cherry cultivars was less (131–312 mg $kg^{-1}$) than the135–1893 mg $kg^{-1}$ found in sour cherries. Anthocyanin level was higher in samples produced under organic farming conditions than in those produced with integrated cultivation.

***Key words:*** cherry; organic farming, integrated cultivation; polyphenols; anthocyanins; antioxidant capacity

## Introduction

Sour (*Prunus cerasus* L.) and sweet (*Prunus avium* L.) cherry are popular fruits in Hungary, They are valuable sources of several bioactive compounds such as poly-phenols (anthocyanins, flavonoids, phenolic acids and related compounds) (*Gao and Mazza*, 1995; *Hilsendegen* et al., 2005). The content of bioactive compound in berry fruits has been associated with their important role in protection human health against serious diseases (*Halliwell,* 2006; *Olsson* et al., 2006). Anthocyanins are responsible for the deep red colour of sweet and sour cherry. Development of red colour is a good index of maturity and has an effect on quality of the crops. The high popularity of sweet and sour cherry can be attributed to their various uses in food industry as fruit juices, jams, canned fruits and filling substances in different bakery and dairy products as well. These fruit cultivars share a relatively high proportion in the fruit production in Hungarian agriculture.

Flavonoids are secondary plant metabolites having an important role in colour of plants and being significant chemical (*Wu and Prior*, 2005) and nutritional components (*Jakobek*, 2007) occurring mostly in glycosylated form. Anthocyanins can be grouped under flavonoids. They are flavonoid-type pigments responsible for red to dark blue colour of fruits, flowers and vegetables. Anthocyanins exist at high concentration in sweet and sour cherries, and their content is cultivar-depending (*Hilsendegen* et al., 2005, *Sass-Kiss* et al., 2007).

Breeding of cherry aims at producing cultivars were with higher yield and quality and suit cultivation with special technologies to increase their antioxidant content. Several research works have been conducted to optimize the organic farming (bio cultivation) to produce on safe materials for human nutrition because different pesticides usually used in traditional cultivation, can threaten human being health, when nor removed through processing of the crops. In literature, however, little information is available on the change of bioactive compounds in cherries as a function of organic farming. The goal of the present work was to investigate the effect of cultivars and cultivation technology (bio/integrated) on the content and composition of bioactive compounds as well as the antioxidant capacity in sweet and sour cherries.

## Materials and methods

All reagents and authentic compounds were of analytical reagent grade or HPLC grade as required. The fruits of different cultivars were obtained from the Research Institute for Fruit growing and Ornamentals, Újfehértó) for the integrated cultivation and Private Farms in Nyíregyháza for bio cultivation. Harvest was in the period between 4$^{th}$ June and 27th of July. The tested cultivars were: sour cherry: Érdi bőtemő (EB), Kántorjánosi (Ka), Újfehértói fürtös (UF), Debreceni bőtermő (DB), Eva (Ev), Petri (Pe), VN-01 (VN1), VN-7 Sz.F. (VN7), Oblacsinszka (Ob), Csengődi (Cs), sweet cherry: Regina (Re), Katalin (K), Firm red (Fi)

Total polyphenolics were measured by photometric method. They were extracted from disintegrated fruit flesh in 80% methyl alcohol. After standing overnight in the

refrigerator, samples were filtered. A colour reaction with Folin-Ciocalteu reagent was performed according to MSZ 9474-80 in an appropriate dilution and given as gallic acid equivalent (GAE).

The free radical scavenging activity of the same filtrate was determined by DPPH method at 36 °C after 30 minutes and expressed as mmol $kg^{-1}$ Trolox equivalent (TEAC) values. (*Brand-Williams* et al., 1995)

After extraction with 2% acetic acid in methanol and clean-up, anthocyanins were determined by HPLC using Waters Millennium chromatographic system consisting of a Model 2690 Separation Module, which includes auto-sampler and gradient pump, and a Model 996 UV photodiode array detector PDA. The operation and data processing was performed by Alliance computer software. For the simultaneous separation of different compounds Nucleodur Sphinx RP column (5 µm, 250 mm × 4,6 mm) and gradient elution were used with solutions A (water/formic acid 90/10) and B (water/formic acid/acetonitril/ 40/10/50). The flow rate was 0.6 ml $minute^{-1}$. The anthocyanins were detected at 520 nm. The quantity of anthocyanin compounds was calculated referring to the area and amount of internal standard callistephin (pelargonidin-chloride 3 glycoside).

Analysis of variance and factor analysis (FA) was performed by MINITAB statistical program.

## Results and discussion

High differences in polyphenol content were found in sour and sweet cherry cultivars. The anthocyanin, the total polypenol content, and antioxidant capacity expressed in Trolox equivalent of sweet and sour cherry cultivars produced by integrated method are shown by *Figure 1*.

The total polyphenolics in sweet cherry cultivars studied were in the range of 880–1050 mg $kg^{-1}$, while that of sour cherries moved in the range of 1283–3490 mg/kg. The anthocyanin content in sweet cherry cultivars was less (131–312 mg $kg^{-1}$) in average than that (135–1893 mg $kg^{-1}$) in sour cherries similarly to total polyphenols. The antioxidant capacity showed the same tendency as polyphenolics. Comparing antioxidant capacity, in sweet cherry samples 5.4–10.3 mmol $kg^{-1}$, and in sour cherry 15–32 mmol $kg^{-1}$ TEAC values were measured. Linear correlation ($R^2 \leq 0.9182$) cold be found between total polyphenol content and the Trolox equivalent antioxidant capacity. It means that antioxidant capacity of cherries primarily depends on the content of total polyphenol compounds of the fruits.

Depending on the cultivars the total polyphenolics and antioxidant capacity (Trolox equivalent) decreased by 2–40% in the sour cherry cultivars studied during one-month storage at low temperature (about 2 ºC).

Investigating the effect of bio and integrated cultivation methods on the polyphenolics and antioxidant capacity, some differences in compound content and composition could be observed as *Figure 2* shows.

The total polyphenol content in cultivars coming from bio farming was lower in two cultivars and higher in one while it was the same in one cultivar. The change of antioxidant capacity was similar to that of total polyphenols. No tendency was observed in these changes. In the same time anthocyanin level, which is about 25% in average of total polyphenols was higher in all the four cultivars from bio farming condition than those from integrated one.

*Figure 3* shows the direction of changes of sour cherry samples by the effect of bio and integrated cultivation technology, using factor analysis for anthocyanin components. Factor analysis is a useful statistical method for data reduction and for simple presentation of large number of variables.

The first two factors accounted for more than 84% of the total variance in the data using anthocyanin compounds as variables. Significant separation in the scores could not be found between integrated and organic samples because of differences among cultivars were higher than between the two cultivation methods. However we observed a definite separation in the factor scores. Score of all bio samples were shifted to the negative direction of the axis of first factor from scores of integrated samples. This moving (Fig. 3B) was caused mainly by the higher content of anthocyanins ($0.95 \leq$ first factor $\geq 0.93$) of bio samples.

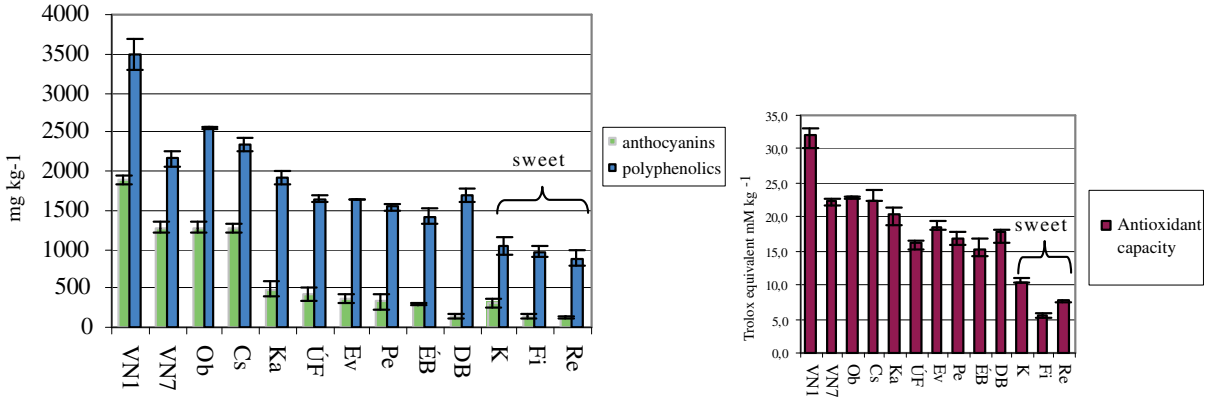


***Figure1. A:*** anthocyanin, total polyphenol content B: antioxidant capacity of sweet and sour cherry cultivars.
anthocyanin, total polyphenol, antioxidant capacity.

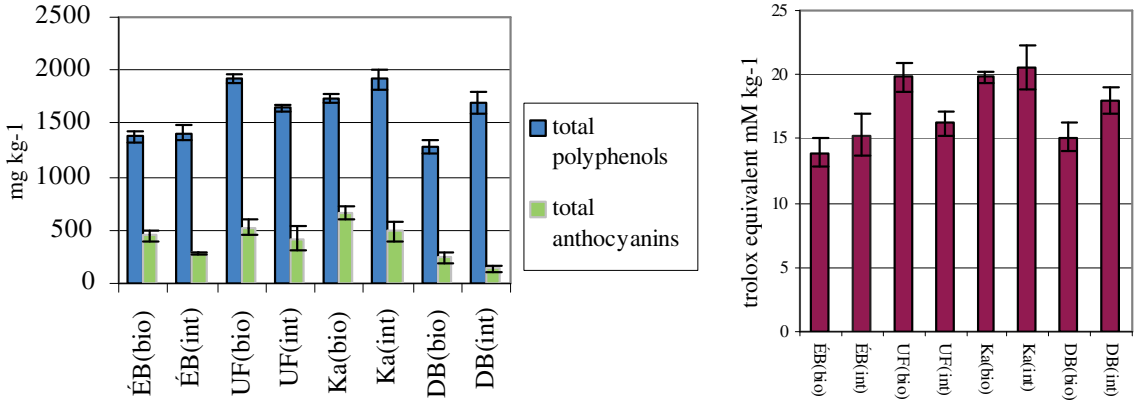


***Figure 2. A:*** anthocyanin, total polyphenol content B: antioxidant capacity of sour cherry cultivars.
anthocyanin, total polyphenol, antioxidant capacity

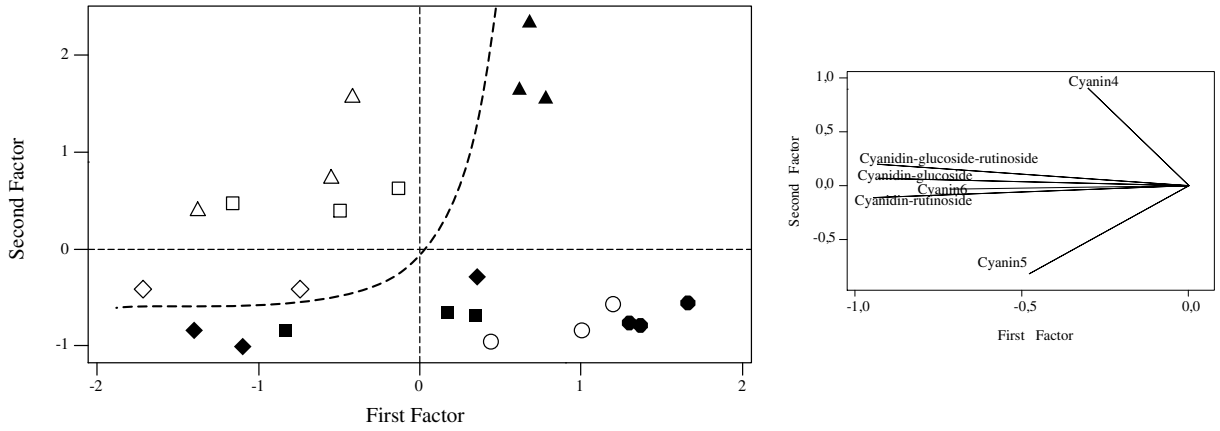


***Figure 3.*** Effect of bio and integrated cultivation technology on anthocyanin composition of sour cherry cultivars, Score **(A)** and loading **(B)** plot of first two Factors. Variables: cyanidin (cy)-glucosyl-rutinoside, cy-glucoside, cy-rutinoside, unknown anthocyanin4, anthocyanin5, anthocyanin6. ÉB ? (int), **?** (bio), Ká? (int) **?** (bio), UF ?(int) **?**(bio), DB ?(int) **?**(bio).

## Conclusion

Polyphenolic compounds, which show a high diversity in cultivars, give mainly the antioxidant activity of sweet and sour cherry cultivars. The storage and the cultivation methods have an effect on content and composition of polyphenols and antioxidant activity of fruits within genetic determination.

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## References

**Brand-Williams, W., Cuvelier, M.E & Berset, C. (1995)**: Use of a free radical method to evaluate antioxidant activity. Lebensm.-Wiss. U.-Technol. 28, 25–30

**Gao, L. & Mazza, G. (1995):** Characterisation, quantitation , and distribution of anthocyanins and colourless phenolics in sweet cherries. J. Agric. Food Chem., 43: 343–346.

**Hallwill, B. (2006):** Perspective, polyphenols: antioxidant treats for healthy living or convert toxins? J. Sci. Food Agric., 86: 1992–1995.

**Hilsendegen, P., Bonerz, C. Patz, D. & Dietrich, H. (2005):** Analytical composition of fruit juices from different sour cherry cultivars. J. Appl. Bot. Food Qual.-Ang Bot., 79: 12–16.

**Jakobek, L., Seruga,I., Novak, M.& Medvidovic-Kosanovic, M. (2007):** Flavonols, phenolic acids and antioxidant activity of some red fruits. Dtsch Lebensm.-Rundsch., 103: 369–378.

**MSZ 9474 ((1980):** Borok polifenoltartalmának meghatározása. (Wines. Determination of polyphenol content.)

**Olsson, M.E., Andersson, C.S., Oredsson, S., Berglund, R.H. & Gustavsson, K.E . (2006):**

**Sass-Kiss, A., Kiss, J. Milotay, P. Kerek, M.M. & Tóth-Márkus, M. (2005):** Differences in anthocyanin and carotenoid content of fruits and vegetables. Food Res. Int. 38: 1023–1029.

**Wu, X. & Prior, R.L. (2005):** Systematic identification and characterisation of anthocyanins by HPLC-ESI-MS/MS in common foods in the United State: fruits and berries. J. Agr. Food Chem. 53: 2589–2599.