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ANTIOXIDANT ACTIVITIES AND PHENOLIC COMPOUNDS IN FRUITS OF CULTIVARS OF CORNELIAN CHERRY (*CORNUS MAS* L.)

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Cornelian cherry (*Cornus mas* L.) is a plant grown in the Eastern and Southern regions of Europe and the Middle East, where it has been used in domestic cuisines for centuries and is one of the most valuable fruit plants in the family Cornaceae Bercht. et J. Presl. It is a very ancient cultural plant in Ukraine known from times of Kyiv on Rus. It wildly used as a valuable food and medicinal plant. All parts of the plant cornelian cherry widely used in folk medicine for the prevention and treatment of many diseases. The aim of this study was to evaluate the antioxidant activity and phenolics content of *Cornus mas* 20 cultivars collected in the M.M. Gryshko National Botanical Garden of NAS of Ukraine. The content of the total antioxidant activity and phenolic compounds from the fruits of the *Cornus mas* twenty cultivars were compared. Antioxidant activity (AOA) was measured using three different photometric methods – DPPH (2.2-diphenyl-1-picrylhydrazyl), ABTS (2.2-azino-bis-3-ethylbenzothiazoline-6-sulfonic acid) and FRAP (Ferric reducing antioxidant power). Total phenolic content (TPC) was evaluated using the Folin-Ciocalteu reagent assay. The results for AOA (μMol Trolox/g) determined by the DPPH method varied from 5.94 (Kozerog) to 16.56 (Kostia), ABTS method varied from 13.560 (Koralovyj Marka) to 33.96 (Semen), FRAP method varied from 8.45 (Koralovyj) to 22.49 (Kostia). The results for TPC varied from 91.34 (Kozerog) to 289.79 (Bolgarskyj) mg/100g. There was recorded a positive linear correlation between antioxidant activity and total phenolic content in the examined plant material. Obtained data showed that investigated cultivars have a potent antioxidant activity that can be used for further investigation and utilization of cornelian cherry. The results of our study also showed that cornelian cherry is an important traditional plant that deserves special attention for widespread growth in Ukraine due to its high biochemical characteristics, as well as useful nutritional and medicinal properties. The fruits of cornelian cherry are promising sources of biologically active substances. Cornelian cherry fruits are a rich source of nutrients for humans. Currently, this plant is less known and this new source can be potential as a functional food or value-added ingredient in the future in our dietary system.

Keywords: cornelian cherry, *Cornus mas*, cultivars, fruits, antioxidant activity, phenolics compounds

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Introduction

The genus *Cornus* L. of family Cornaceae Bercht. et J. Presl. consists of about 65 species and is widely distributed in the northern hemisphere with centers of diversity in southern and central Europe, southwest Asia, eastern and western North America and mountains of Central America, South America and East Africa (Eyde, 1988). Among the *Cornus* species, four species namely *Cornus mas* L., *C. officinali*s Siebold & Zucc., *C. chinensis* Wangerin and *C. kousa* F. Buerger ex Hance bear edible fruits that are consumed in different parts of Europe and Asia (Seeram et al., 2002).

The cornelian cherry (*Cornus mas*) is one of the most valuable fruit plants and known in garden cultivation for 4000 years. This plant comes from the foothills of the Caucasus and from there it spreads over Turkey, Romania, Bulgaria, and Italy and to the inland European continent (Dolejsi et al., 1991; Klimenko, 2004a, b; Brindza et al., 2009).

Cornelian cherry was and still is, known for its flavor, nutritional and medicinal benefits. Chemical composition of fruits of cornelian cherry rich enough. Biologically active compounds, such as vitamin C, organic acids (mainly malic acid), pectins (Seeram et al., 2002; Kucharska et al., 2011; Kucharska, 2012), phenolic acids (gallic and ellagic, and derivatives of hydroxycinnamic acids) (Pantelidis et al., 2007; Kucharska, 2012), flavonoids (anthocyanins, flavonols) (Tural and Koca, 2008; Pawlowska et al., 2010; Kucharska et al., 2015), triterpenoid (ursolic acid) (Yayaprakasam et al., 2006), iridoids (Kucharska et al., 2015; Klymenko et al., 2016), and recently identified iridoids (loganic acid, cornuside, loganin, sweroside) (West et al., 2012; Deng et al., 2013) have been reported in fruits of cornelian cherry. These compounds are purported to be beneficial for the prevention of heart disease and diabetes. Fruits and drugs of them (decoctions, tinctures, teas, concentrates of fresh and dried raw materials) exhibit antiscorbutic, antibacterial, anti-inflammatory, antioxidant, general health-improving, tonic, astringent, temporary hypotensive, and diuretic properties (Seeram et al., 2002; West et al., 2012). Fresh fruits recommend 10–12 g/day for neurasthenia, common weakening, joint pains, infectious hepatitis, and others. Cornelian cherry fruits also were used in folk medicine for the treatment of various fever-related diseases (flu, sore throat, and malaria) and gastrointestinal disorders.

The fruits, flowers, leaves, seeds, and bark in *Cornus mas* have been known and appreciated in folk medicine for years, especially in Asia and is a rich source of anthocyanins, phenolic acids, tannins, carotenoids, flavonoids, flavanols, iridoids, organic acids, vitamins (Du and Francis, 1973a, 1973b; Jensen et al., 1973; Zargari, 1997; Klimenko, 2004; Brindza et al., 2007; Horvath et al., 2007; Leskovac et al., 2007; Pantelidis et al., 2007; Kucharska et al., 2009; Savikin et al., 2009; Yilmaz et al., 2009; Pawlowska et al., 2010; Hassanpour, 2011; Deng et al., 2013; Cetkovska et al., 2014; Drkenda et al., 2014; Krivoruchko, 2014; Sochor et al., 2014; Behrangi et al., 2015; Milenkovic-Andjelkovic et al., 2015; Rudrapaul et al., 2015).

The pharmacological studies showed antibacterial (Jayaprakasam et al., 2006; Mirbadalzadeh and Shirdel, 2010; Radovanović et al., 2013; Asgary et al., 2014; Soltani et al., 2015; Shishehbor et al., 2016), hypolipidemic (Jayaprakasam et al., 2006; Sozański et al., 2016), antioxidant (Tural and Koca, 2008; Popović et al., 2012), anticoagulant (Rafieian-Kopaei et al., 2011), antiparasitic (Mehrabi et al., 2012), cardioprotective (Alavian et al., 2014; Badalica-Petrescu et al., 2014; Darbandi et al., 2016), anticancer (Rezaei et al., 2014), hepatoprotective (Somi et al., 2014), and anti-inflammatory (Moldovan et al., 2016; Sozański et al., 2016) effects of the *Cornus mas* fruits.

There are many recipes of different foods prepared from cornelian cherry and supplied in private communications, such as cornelian cherry in sugar, lavash, syrup, juice, jam, candied fruits, jelly, marmalade, compote, wine, fruit drink, marinated cornelian cherry, cornelian cherry liqueur, pickles and so on (Brindza et al., 2007; Pantelidis et al., 2007; Klymenko et al., 2017). Refreshments from cornelian cherry are very tasty. Methods of using cornelian cherry as food raw materials are very diverse. Local people where cornelian cherries are known from immemorial time to prepare national dishes from cornelian cherry. Especially appreciated are Caucasus products called 'Turshu' and 'Lavash' – these are concentrates (they are stored for a long time) used as a product with a high content of vitamins, and fine seasoning for various dishes, especially meat. Fresh fruits can be stored for a long time, frayed or sprinkled with sugar. Very tasty are cornelian cherries frozen and canned in sugar syrup.

The aim of this study was to evaluate the antioxidant activity and phenolics content of twenty *Cornus mas* cultivars. Obtained data showed that investigated cultivars have a potent antioxidant activity that can be used for further investigation and utilization of *Cornus mas*.

Material and methodology

Biological material

The fruits of 20 cultivars of *Cornus mas* collected and selection in the M.M. Gryshko National Botanical Garden of NAS of Ukraine (NBG) were the objects of these investigations. The raw material was collected in the period (September) of full ripeness.

Chemicals and spectral measurements

1.1-diphenyl-2-picrylhydrazyl (DPPH) ferrous chloride, tripyridyltriazine (TPTZ), kaliumperoxodisulfat, 2.2'-azino-bis(3-ethylbenzthiazoline-6-sulphonic acid) (ABTS), 6-hydroxy-2,5,7,8-tetramethylchroman-2-carboxylic acid (Trolox), gallic acid were obtained from Sigma Chemical Co. (Sigma-Aldrich, Poland, Poznań). Methanol was obtained from POCh Poland. All chemicals and solvents were of analytical grade. All UV–V measurements were recorded on a Shimadzu UV–2401PC (Kyoto, Japan).

Preparation of extracts for analysis of total polyphenols and antioxidant activity

The amount of about 2 g of fruits was homogenized and extracted with 80% aqueous methanol to a final volume of 20 mL at room temperature. The extraction was performed in the ultrasonic bath (Polsonic, Poland) for 15 minutes. All extracts were filtered through pickling mixture paper filters (Whatman filter No. 1), and then they were subjected to analyses.

Determination of total polyphenols content (TPC)

Total phenolic contents of fruits were determined by using the Folin-Ciocalteu reagent method according to Gao et al. (2000). Plant extracts (0.1 mL) were mixed with 0.2 mL of Folin-Ciocalteu reagent and 2 mL of H_2O and after 3 min 1 mL 20% sodium carbonate. Total polyphenols were determined after 1 h of incubation at room temperature in the dark. The absorbance of the resulting blue colour was measured at 765 nm with a Shimadzu UV-VIS spectrophotometer. The standard curve was prepared using different concentrations of gallic acid. The results were calculated as mg of gallic acid equivalent (GAE)/1 g. All the determinations were performed in triplicates.

Determination of Reducing power, (FRAP) radical scavenging activity

Ferric reducing antioxidant power (FRAP) was measured suing Benzie and Strain (1996). An aliquot (1.0 ml) of the diluted extract was added to 3 ml of FRAP solution (acetate buffer (300 µM, pH 3.6), a solution of 10 µM TPTZ in 40 µM HCl, and 20 µM $FeCl_3$ at 10 : 1 :1 (*v*/*v*/*v*) ratio). The mixture was shaken and left at room temperature for 10 min. The absorbance was read at 593 nm after 10 minutes using a Shimadzu UV2401PC spectrophotometer. The standard curve was prepared using different concentrations of Trolox. The results of the assay were expressed in µM Trilox per 1 g. All the determinations were performed in triplicates.

Determination of (DPPH) radical scavenging activity

The DPPH free radical scavenging activity of fruits extracts was measured from bleaching of the purple colour of (2.2-diphenyl-1-picrylhydrazyl) out as described by Yen and Chen (1995). Exactly 0.5 ml solution of different concentrations of the extract was added to 2 ml of DPPH. The mixture was shaken and left at room temperature for 10 min. The absorbance was measured at 517 nm, using a Shimadzu UV2401PC spectrophotometer. The standard curve was prepared using different concentrations of Trolox. The results of the assay were expressed in µM Trolox per 1 g. All the determinations were performed in triplicates.

Determination of ABTS radical scavenging activity

ABTS (2.2‘-azino-bis (3-ethyl benzothiazoline-6-sulfonic acid) assay was based on the method of Re et al. (1999). Briefly, ABTS radical cation is generated by reacting 7 mM ABTS and 2.45 mM potassium persulfate via incubation at room temperature (23 °C) in the dark for 12–16 h. The ABTS solution was diluted with to an absorbance of 0.700 ±0.040 at 734 nm. The reagent blank reading was taken (A_0). After the addition of 3.0 ml of diluted $ABTS^+$ solution to 30 µl of plant extracts, the absorbance reading was taken exactly 6 min after the initial mixing (A_t). The standard curve was prepared using different concentrations of Trolox. Results of antioxidant activity were expressed in µMol Trolox equivalents (TE)/g. All the determinations were performed in triplicates.

Statistical analysis

Basic statistical analyses were performed using PAST 2.17; hierarchical cluster analyses of similarity between phenotypes were computed on the basis of the Bray-Curtis similarity index. Data were analysed with ANOVA test and differences between means compared through the Tukey-Kramer test ($\alpha = 0.05$). Correlation coefficients were calculated by CORR analysis.

Results and discussion

Cornelian cherry is well known across Europe. In countries such as Austria, Bulgaria, England, Hungary, Moldova, Poland, Slovakia and Ukraine, this species has been known in the culture for hundreds of years and is widely used as a valuable edible, medicinal and ornamental plant. But only in recent decades, breeding programs aimed at the development of large fruit and high-yielding trees have been launched in several countries. Today, the selection of large-fruited cultivars are characterized by the following: different fruit shapes, smaller stones, desirable chemical composition, and different maturity dates on the same plant. Both producers and consumers desire such fruits.

In the NBG for 50 years selection work with cornelian cherry has been carried out. 14 cultivars were created which are included in the Register of Varieties of Ukraine. The gene pool of more than fifty cultivars and varieties created. Best cultivars of our selection are Evgenia, Semen, Coralovyi Marka, Svetlyachok, Elena, Vydubetskyi, Elegantnyi, Luk'yanovskyi, Exoticheskyi, Radost, Nikolka, Vavilovets, Vladimirskyi, Grenader (Klymenko et al., 2017a, b).

The first stage was the analytical selection when we used the results of the spontaneous selection. As a result of second stage – synthetic selection (cultivated forms of cornelian cherry of diversified origin were used) cultivars were developed that are characterized by steady annual fructification, with diverse biochemical properties and practical and valuable characteristics (mass, shape, color fruit, ripening and other), high productivity, and frost resistance under the conditions of the Forest-Steppe (Klymenko et al., 2017a, b). The shiny fruit is red, dark red cherry red, pink, or yellow, while the fruit can be oval, pear or bottle-shaped (Figure 1). Yellow fruited cultivars are either rare or no longer occur in the wild (Klimenko, 2004). The average fruit mass is 5.0–8.0 g, the maximal average is 9.0–10.0 g. The mass of the stone 7.5–11.0% from the mass of the fruit. They contain 8.0 to 15.0% of sugars; 1.3–1.9% of organic acids; 101.0–193.0 mg% of vitamin C; 670.0–850.0 mg% of anthocyanin the skin, and 36.0–121.3 mg% in the pulp (Klymenko et al., 2017a, b).

Plants have long been a source of dietary antioxidants. It is believed that two-thirds of the world's plant species have medicinal importance, and almost all of these have excellent antioxidant potential (Krishnaiah et al., 2011). Antioxidant activity of plants as *Chaenomeles japonica* (Thunb.) Lindl. Ex Spach (Zhang et al., 2010), *Cornus mas* L. (Kucharska et al., 2011; Milenkovic-Andjelkovic et al., 2015), *Pseudocydonia sinensis* Schneid. (Monka et al., 2014; Grygorieva et al., 2019), *Morus nigra* L. (Kucelova et al., 2016), *Ziziphus jujuba* Mill. (Ivanišová et al., 2017), *Diospyros virginiana* L. (Grygorieva et al., 2018), *Sambucus nigra* L. (Horčinová Sedláčková et al., 2018), *Asimina triloba* (L.) Dunal (Brindza et al., 2019) were discussed recently.

Figure 1 Fruits of different cultivars of *Cornus mas* L. selection of M.M. Gryshko National Botanical Garden (Kyiv, Ukraine)

Antioxidant activity of *Cornus mas*

The DPPH radical scavenging activity of each *Cornus mas* cultivars extracts is shown in Figure 2.

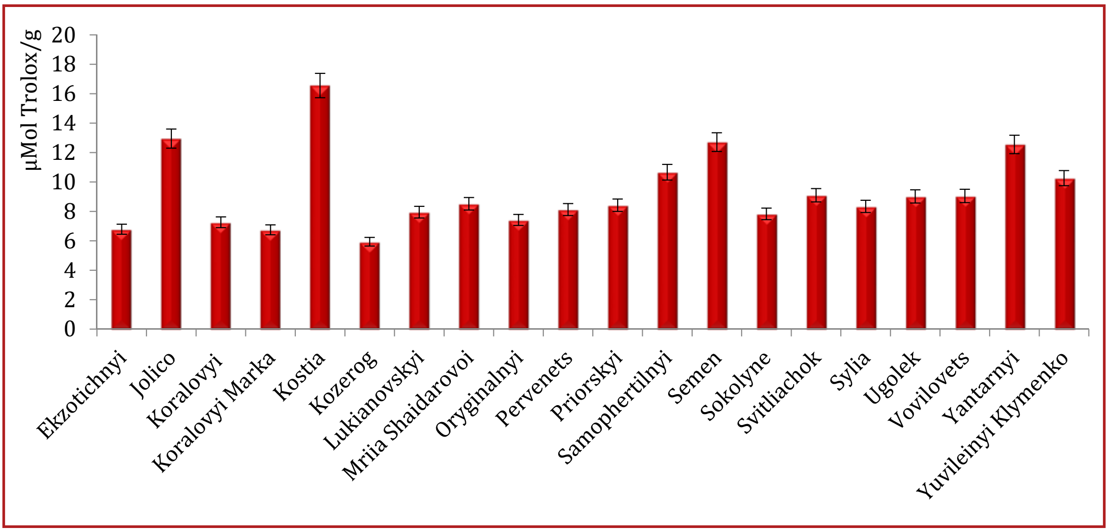

Figure 2 Antioxidant activity of *Cornus mas* L. cultivars evaluated by DPPH method (µMol Trolox/g)

Antioxidant activity of cornelian cherry cultivars ranged from 5.94 (Kozerog) to 16.56 (Kostia) µMol Trolox/g.

Milenkovic-Andjelkovic et al. (2015) study, 100 ml of cornelian cherry fruit extract can scavenge 94–109 mg of dissolved DPPH radicals. Tural and Koca (2008) reported that the methanolic extracts of the cornelian cherry fruits showed EC50 (mg/ml) (DPPH reduction) values as 0.52. Dragovic-Uzelac et al. (2007) determined that DPPH values in two different cornelian cherry types were between 33.41 and 39.89 mmol Trolex equivalent/kg f.w. Paulovicsova et al. (2009), found that the antiradical activities were 77.59–84.56 and 88.85% in three cornelian cherry types. Hassanpour et al. (2011) stated that the efficiency of DPPH radicals' scavenging depends on the total polyphenolic concentration, total flavonoids, and ascorbic acid content. In the cited study, fruit extracts scavenged DPPH radicals at levels varying from 38.98 to 77.6%. According to Kucharska et al. (2011), antioxidant activity in Polish breeding cultivars was the highest in Dublany cultivar (20.72 µMol Trolox/g) and the lowest in Juliusz cultivar (10.85 µMol Trolox/g).

Other stable free radical cation, $ABTS^+$, was used to evaluate the antioxidant activity of the cornelian cherry extracts (Figure 3).

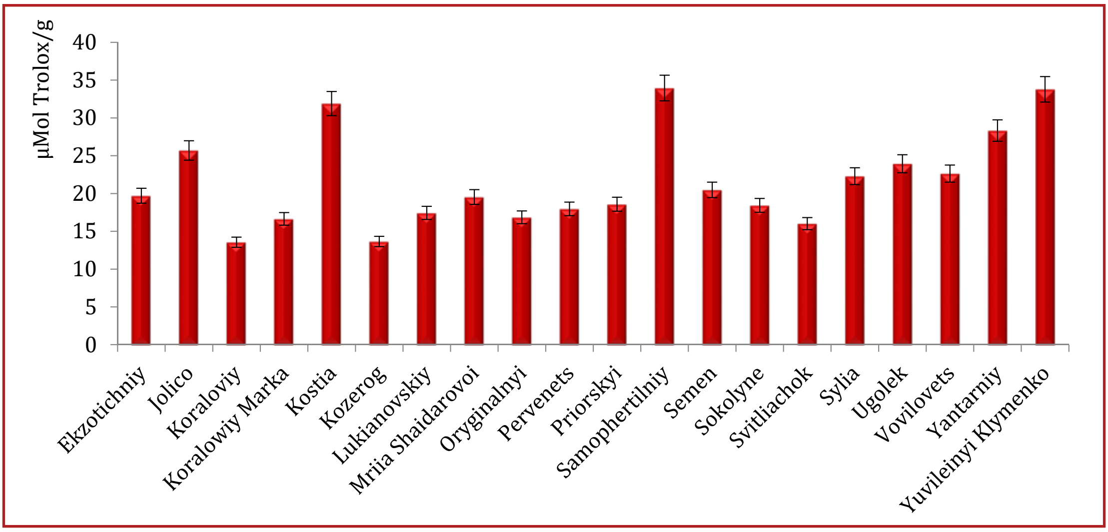

Figure 3 Antioxidant activity of *Cornus mas* L. cultivars evaluated by $ABTS^+$ method (µMol Trolox/g)

As shown in Figure 2 antioxidant activity of extracts of cornelian cherry cultivars measured by ABTS·+ ranged from 13.56 (Koralovyi Marka) to 33.96 (Semen) µMol Trolox/g and had the most results comparing with other methods. These results indicated that the cornelian cherry extracts have different radical scavenging activity depending on cultivars.

Moldovan et al., (2016) reported that the antioxidant activity of fresh cornelian cherries was 677.88 ±19.25 mol Trolox equivalents/100 g FW (ABTS assay). According to Rop et al. (2010), the content ranges of fruits from 3.65 (cv. Devin, Polish breeding) to 10.28 (Vydubeckyi, Ukrainian breeding) g GAE kg-1 FM. According to Kucharska et al. (2011) antioxidant activity in Polish breeding cultivars the content ranges of fruits from 18.87 (cv. Juliusz) to 38.96 (cv. Szafer) µMol Trolox/g.

Antioxidant activity of cornelian cherry cultivars evaluated by the FRAP method (Figure 4) ranged from 8.45 (Koralovyi) to 22.49 (Kostia) µMol Trolox/g. FRAP assay uses antioxidants as reductants in a redox-linked colorimetric method employing an easily reduced oxidant system.

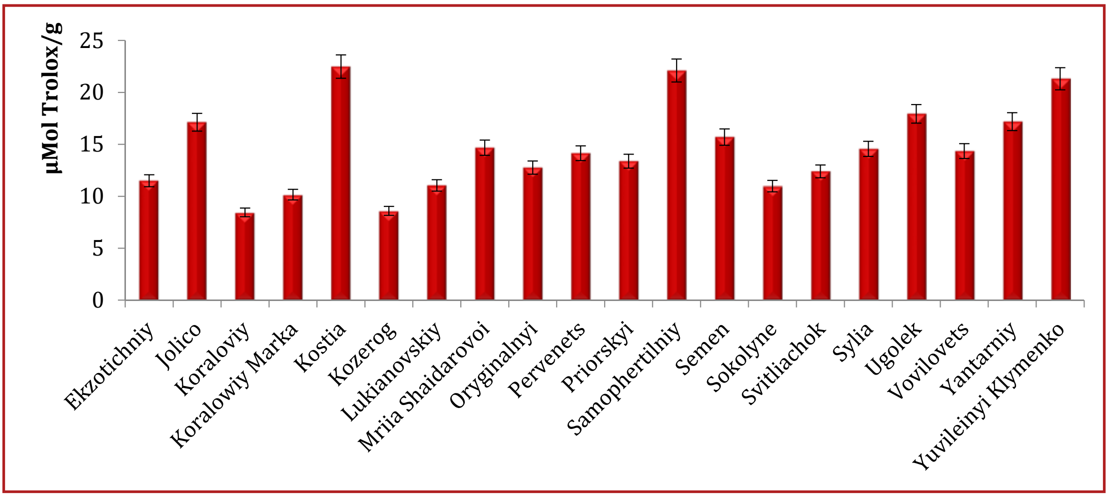

Figure 4 Antioxidant activity of *Cornus mas* L. cultivars evaluated by FRAP method (µMol Trolox/g)

According to Kucharska et al. (2011) antioxidant activity in Polish breeding cultivars the content ranges of fruits from 21.17 (cv. Juliusz) to 41.08 (cv. Szafer) µMol Trolox/g. According to Biaggi et al. (2018), the Cornelian cherry extract can reduce 20.41 µmol Fe^{2+} per gram of solution. A study conducted by Yilmaz et al. (2009) presents a significant range of FRAP values, in which the minimum is 73 and the maximum reaches 114 µmol AA (ascorbic acid) equivalent per gram of DW. Pantelidis et al. (2007) confirm that the FRAP value is approximately 84 µmol AA/g DW. However, Popovic et al. (2012) present a different range for this parameter, which is probably caused by a data presence question. In their study, the ferric-reducing antioxidant power ranges from 2 to 65 µmol/ml Fe^{2+}.

The cluster analysis (CA) was performed according to the hierarchical cluster analysis (HCA) method using the mean value to distinguish similar groups among the various antioxidant capacities. In this study, twenty genotypes were grouped into five main clusters based on the highest similarities (Figure 5). Yuvileinyi Klymenko, Yantarnyi, Semen and Kozerog (the last cultivar showed a high value only with the ABTS method) represented the highest values by the FRAP, ABTS, and DPPH assays; the third group had the lowest values of antioxidant activity; the fourth group includes the largest number of varieties with similar data as determined by the DPPH, FRAP and ABTS methods: Group 1: Yuvileinyi Klymenko, Yantarnyi and Semen; Group 2: Kostia, Samophertilnyi, Jolico and Ugolek, Group 3: Koralovyi Marka, Lukianivskyi and Sokolyne; Group 4: Svitliachok, Oryginalnyi, Sylia, Priorskyi, Pervenets and Mriia Shaidarovoi; Group 5: Ekzotychnyi, Vovilovets and Koralovyi.

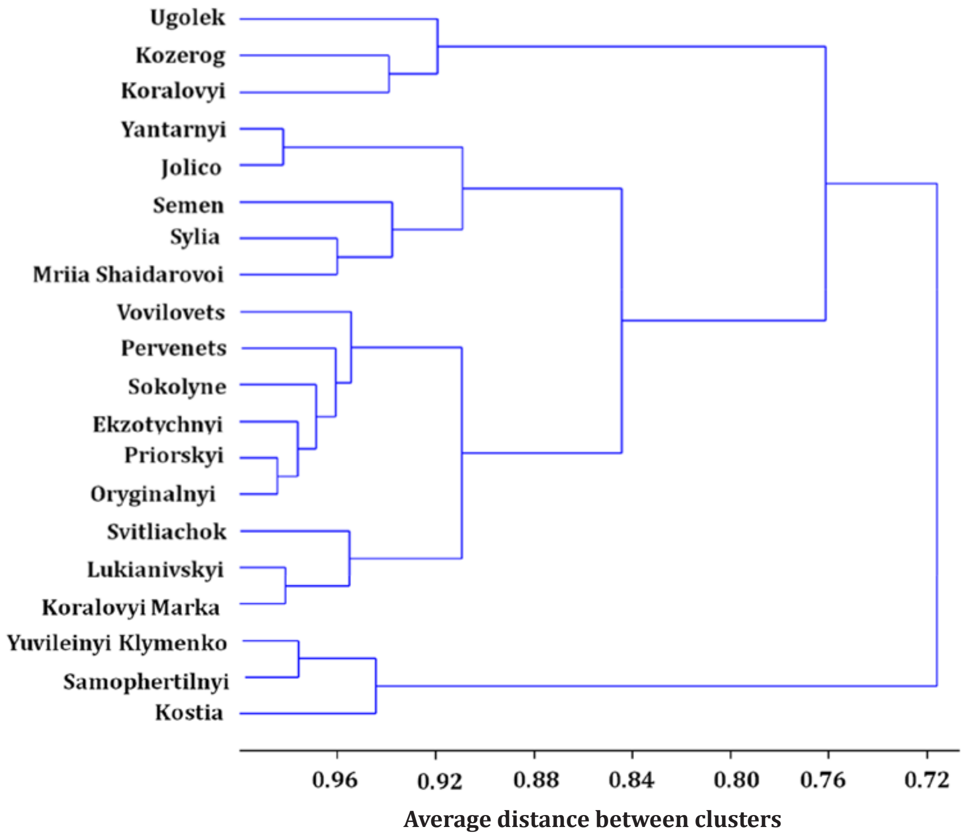

Figure 5 Cluster diagram of the antioxidant activity (FRAP, ABTS, and DPPH methods) of 20 cultivars *Cornus mas* L.

Assessment of total polyphenol content

The results for TPC determined by the Folin-Ciocalteu method varied from 91.34 (Kozerog) to 289.79 mg/100 g (Yuvileinyi Klymenko) (Figure 6).

The obtained results were within the limits of the values published by several authors for cornelian cherries from Greece, Czech Republic, Poland, Romania, Azerbaijan, Turkey (Tural and Koca, 2008; Yilmaz et al., 2009; Hashempour et al., 2010; Rop et al., 2010; Kucharska et al., 2011; Cetkovska et al., 2014). Rop et al. (2010) stated that the total amount of polyphenolic content was cultivar dependent. In their study, the total polyphenolic content was the lowest for the cv. Devin Czech breeding (261 mg GAE/100 g FW), and the cv. Vydubieckii Ukrainian breeding had the highest concentration of polyphenol (811 mg GAE/100 g FW). The total phenolic content of *Cornus mas* of Greece cultivars was 1,592 mg GAE; of Azerbaijan cultivars, 1,097–2,695 mg GAE; of Turkey cultivars, 2,659–7,483 mg GAE (Yilmaz et al., 2009; Cetkovska et al., 2014). According to Cetkovska et al. (2014), total polyphenol content in Ukrainian breeding cultivars was the highest in Ekzotichnyi cultivar (614.3 mg GAE per 100 g DW) and the lowest in Lukianivskyi cultivar (182.3 mg GAE per 100 g DW). According to Romanian researchers, the determined total phenolic content of the fresh ripe fruits of Cornelian cherry acquired from a local market from Cluj-Napoca was 489.94 ±17.88 mg/100 g FW expressed as GA equivalents (Moldovan et al., 2016). Kucharska et al. (2011) presented research cultivars Polish breeding, that the richest in polyphenols was cv. Szafer (464 mg/100 g) and the poorest was cv. Juliusz (262 mg/100 g).

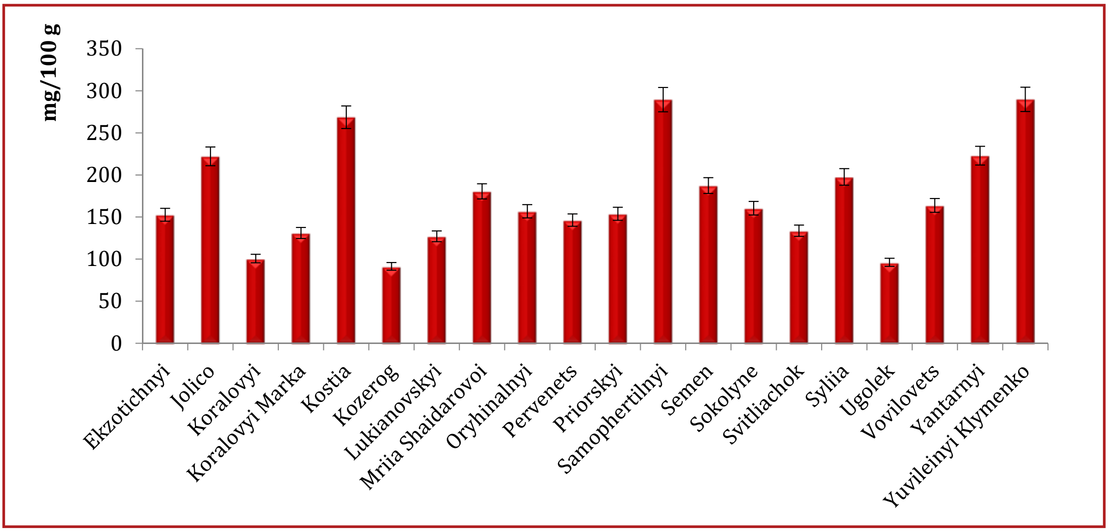

Figure 6 Total polyphenol content of cultivars of *Cornus mas* L. fruits extracts based on gallic acid equivalents (GAE, Line) (mg/100 g)

Polyphenol content can be linked to the amount of juice and peel color (Demir and Kalyoncu, 2003; Bijelić et al., 2011; Cosmulescu et al., 2018). Cultivar Szafer possessed the most intense purple color of all cultivars, and it was also the richest in TPC among the cultivars tested by Kucharska et al. (2011). Milenkovic-Andjelkovic et al. (2015) indicated in their study that the polyphenol content slightly depended on the cultivation conditions which differ from year to year (90 mg GAE/g DW in 1 year and 91 mg GAE/g DW in the following one).

The differences in total polyphenol content may be caused by the different extraction methods used in that study compared to the other studies.

Results on the basis of polyphenolic compounds are distributed into four basic groups by cluster analysis as we can see at Figure 7: Group 1: Yantarnyi, Jolico, Sylia, Semen, and Mriia Shaidarovoi; Group 2: Pervenets, Vovilovets, Sokolyne, Priorskyi, Ekzotychnyi, Oryginalinyi, Lukianivskyi, Svitliachok and Koralovyi Marka; Group 3: Kozerog, Ugolek and Koralovyi; Group 4: Bolgarskyi, Samophertilnyi and Kostia.

The fourth group can be distinguished by the highest content polyphenols. As for the representatives of the third group, they have the lowest content of polyphenols.

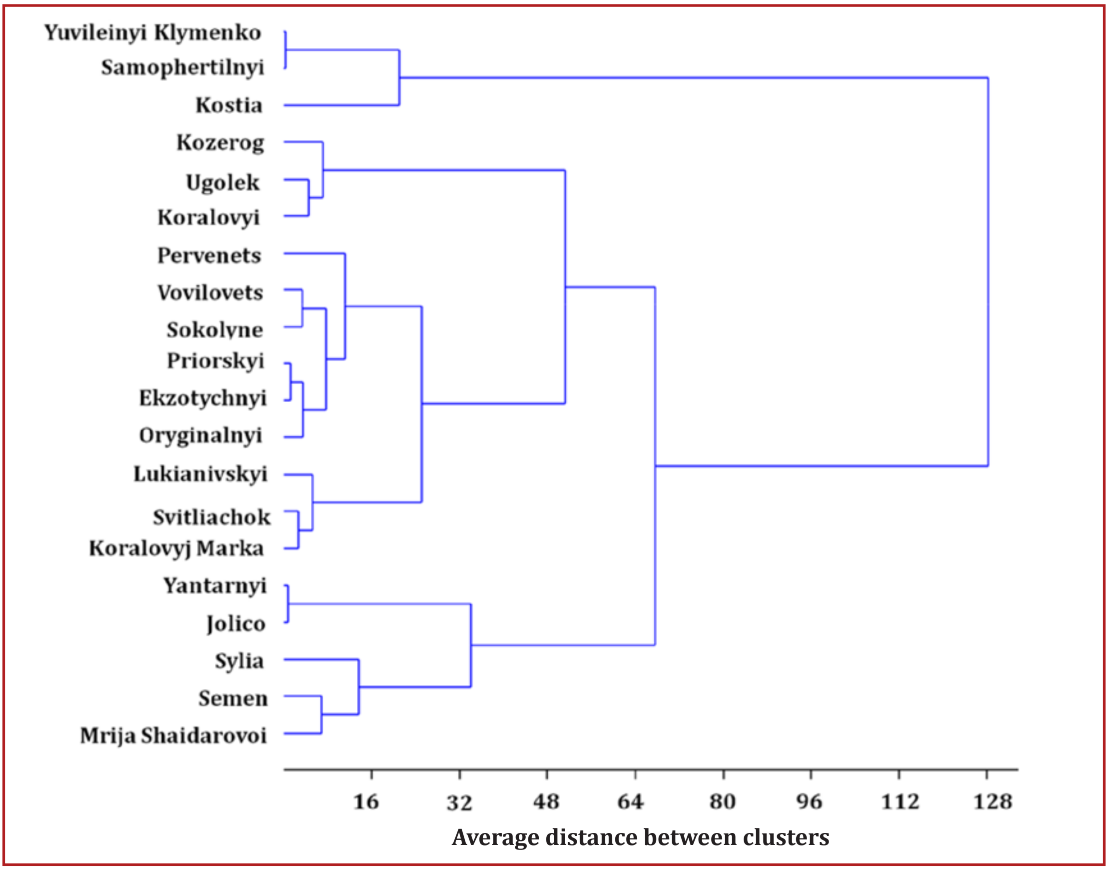

Figure 7 Cluster diagram of polyphenolic compounds of 20 cultivars *Cornus mas* L.

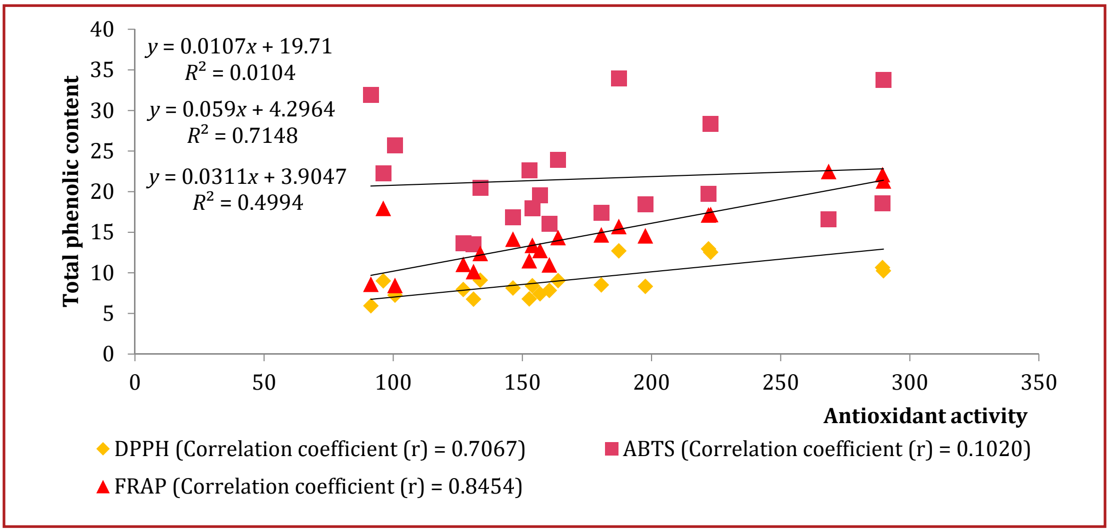

Figure 8 Linear correlation between the total phenolic content and antioxidant activity

Correlation analysis was used to explore the relationships between the individual phenolic compounds and antioxidant capacities (ABTS, DPPH, and FRAP) measured for all fruit extracts from twenty *Cornus mas* cultivars (Figure 8).

The findings of this study indicate that TPC present high and positive correlations with FRAP scavenging capacity and DPPH (r = 0.845, p <0.05; r = 0.706, p <0.05, respectively). Between the TPC and ABTS there is a very weak correlation (r = 0.102).

The correlation analysis between radical scavenging and polyphenolic composition has been additionally proven in many studies (Pantelidis et al., 2007; Ersoy et al., 2011; Milenkovic-Andjelkovic et al., 2015).

Conclusions

The antioxidant activities and total phenol contents of fruit extracts from twenty *Cornus mas* cultivars were studied. Interest in new sources of anti-inflammatory and antioxidant compounds has recently become a major research issue. Cornelian cherry receiving particular attention for its significant amounts of phenolic compounds and vitamins, which exhibit a wide range of biological and pharmacological properties. Obtained data showed that investigated cultivars have a potent antioxidant activity that can be used for further investigation and utilization of cornelian cherry. The results of our study also showed that cornelian cherry is an important traditional plant that deserves special attention for widespread growth in Ukraine due to its high biochemical characteristics, as well as useful nutritional and medicinal properties. Cluster analysis allows us to determine the possible relationships between the analyzed cultivars based on the observed parameters. The amount of these compounds depends on the plant genotype and the ripeness of fruits. Currently, this plant is less known and this new source can be potential as a functional food or value-added ingredient in the future in our dietary system.

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