Abstract

Rosa canina L. fruit have been used internally as tea for treatment of viral infections and disorders of the kidneys and urinary tract. Also, it was reported that the R. canina fruit, with its high ascorbic acid, phenolics and flavonoids contents, have antioxidant, antimitogenic and anticarcinogenic effects. Antioxidants neutralize free radicals, which cause oxidative damage to lipids, proteins, and nucleic acids and thus protect the organism. Research studies conducted on this topic have shown that natural antioxidants are involved in protection against many diseases: cancer, cardiovascular diseases and osteoporosis. Different processing and storage methods of the fruit could affect the bioactive nutrients while preserving the antioxidant capacity of them is very important. The aim of this study was to evaluate the effect of storage in a dry or frozen state on the antioxidants content of R. canina fruit. The evaluation involved determination of carotenoids, ascorbic acid and total polyphenols using spectrophotometrically methods. Analysis performed on the R. canina fruit showed significant changes in the antioxidants content in fresh, dried and frozen fruit during storage.

Keywords: antioxidants, dried, frozen, Rosa canina L., storage.

INTRODUCTION

Rosa canina L., commonly known as dog rose, is a spontaneous wild rose species native not only to Europe, but also to northwest Africa and western Asia. The flower is one of the national symbols of Romania. The pseudo fruits, which are called rose hips, are aggregate fruits consisting of several achenes enclosed by an enlarged, red, fleshy floral cup. The rose hips of R. canina are, to the knowledge of the authors, the only rose hips with proven medicinal activities (Winther et al., 2016). Rosa canina fruit have been used in herbal remedies since ancient times. Both in vivo and in vitro studies have demonstrated that this fruit exhibits anti-inflammatory, antioxidant, antimitogenic, anticarcinogenic and anti obesogenic effects (Mármol et al., 2017). The health benefits of rose hips have been attributed to its wide range of bioactive compounds with antioxidant properties including vitamin C, phenolics, lycopene, lutein, zeaxanthin and other carotenoids (Cui et al., 2014). Recently antioxidant properties are associated with antiproliferative and antitumoral effects. Beside this, antioxidants are used as additive in the food-processing industry with the aim of preventing an oxidizing deterioration of the lipids as well as preventing loss of food nutrition values (Marmol et al., 2017). In this respect previous study reported that Rosa canina rose hips ingredient can be used in porcine frankfurters instead of sodium nitrate so that the concentration of this additive could be reduced (Vossen et al., 2012).

The Rosa canina fruit are also rich in minerals, other vitamins (thiamine, riboflavine, niacine, tocopherols), sugars, bioflavonoids, tannins, organic acids, aminoacids, volatile oils and pectin (Ozcan et al., 2004; Ercisli, 2007; Dubtsova et al., 2012). All vitamins are bioactive as numerous studies on the subject showed. In particular, the antioxidant potential of vitamins C and E has been subjected to extensive researches in recent years (Halvorsen et al., 2002; Kiokias et al., 2008). Beside its antiscorbutic action,
explainable by its involvement in collagen synthesis, vitamin C plays a role in several important enzymatic syntheses such as synthesis of dopamine, carnitine, a number of neuroendocrine peptides and in the transformation of cholesterol into bile acids (Winther et al., 2016). Polyphenols are secondary metabolites of plants and are generally involved in defense against UV radiation or pathogens aggression. In recent years there has been much interest in the potential health benefits of dietary plant polyphenols as antioxidant. Moreover, vitamin C and total polyphenols are quality markers traditionally used to assess the effect of treatments and storage on vegetables (Catunescu et al., 2017).

Studies in carotenoids have shown bioactivity, as carotenoids are associated with antioxidation both in vitro and in vivo (Bub et al., 2000; Kiokias et al., 2003). Dietary carotenoids have been associated with induction of apoptosis, inhibition of mammary cell proliferation and have also been suggested to have some anti-cancer properties (Wigle et al., 2008; Horváth et al., 2012). Also, these pigments can be used as a natural dye in food, pharmacy and cosmetic industry, because they are natural and non-toxic (Goodwin, 1980).

The *Rosa canina* L. fruit have constituted an important source of food and medicine for many cultures. Rose hips can be used either fresh or dried. Fresh fruit utilization is for production of jam, jelly, marmalade, syrup, wine and soft drinks while the dried fruits and roots are excellent for making tea (Moerman, 2002; Ercisli and Guleryuz, 2005; Uggla et al., 2005). *Rosa canina* fruit have been used internally as tea for treatment of viral infections and disorders of the kidneys and urinary tract. In order to investigate potential uses of *Rosa canina* fruit theirs nutrients content and technological properties were determined. Previous scientific studies reported that vitamin C content in rose hips to far exceed the one found in citrus fruits (Ercisli, 2007). Rose hips are known to have the highest vitamin C content (30–1300 mg/100 g) among fruits and vegetables (Cui et al., 2014). Beside the vitamin C, also carotenoids content varies within wide limits (9.7-62 mg/100g) (Özkan et al., 2004).

Present study aims to evaluate the effect of storage, in a dry or frozen state, on the vitamin C, total carotenoids and total polyphenols content of *Rosa canina* fruit. Also the influence of the drying processing of this fruit on the content of the mentioned antioxidants was studied as the whole dried fruit and the powder obtained by its milling were compared. Analysis of these results could give some indication of the most appropriate method of plant processing to obtain some commercial form of tea (whole fruits or powder for tea bags) serving for therapeutic use. In the same time these processed pseudo-fruits could constitute an alternative source of antioxidants for the food industry.

### MATERIALS AND METHODS

#### Plant material

Fresh *Rosa canina* L. fruit, commercial available and widely used in everyday life, were purchased from the local market. Effect of six months storage on the antioxidants content in frozen and dried condition was evaluated. Fruit freezing was performed in the freezer at -18°C; drying of the fruit was done in a Venticell oven at 60°C.

The biochemical analysis of dried fruit were performed on both whole and powder state (obtained by grinding of the dried fruit).

#### Chemical composition

**Ascorbic acid content**

Ascorbic acid content was estimated by colorimetric method with a dye solution of 2,6-dichlorophenol indophenol (Artenie and Tanase, 1981). Extraction of ascorbic acid was made in 2% oxalic acid. This method is based on measurement of the extent to which a 2,6-dichlorophenol-indophenol solution is decolourised (reduced) by ascorbic acid in sample extracts and in standard ascorbic acid solutions. The excess dye is taken up in xylene and colour measured at 500 nm with UV-VIS Thermo Spectronic Helios spectrophotometer. Results were expressed as mg of ascorbic/100 g dry weight.

**Total carotenoids content**

Total carotenoids content was performed using also a spectrophotometric method. The
determination method is based on STAS 13058-91 adapted to a complex matrix (Balan et al., 2016). The sample was grinded and repeatedly extracted with 80% acetone until a colourless residue was obtained. The partial extracts were collected and filtered, obtaining a total volume of extract. The absorbance at 452 nm was measured with a UV/Visible Thermo Spectronic Helios spectrophotometer. Total carotenoids content was expressed as mg/100 g dry weight.

**Total polyphenols content**

Total polyphenols content was performed according to the modified Folin-Ciocalteu assay (Singleton et al., 1999) (on methanolic extracts) after extraction in a mixture of water-methanol, since researches have proved that polar solvents are more effective in the extraction of these bioactive compounds (Spulber et al., 2017). The determination method consists in chemical reduction of Folin-Ciocalteu reagent (which is a mixture of tungsten and molybdenum oxides) and measuring the intensity of the obtained blue colour at 750 nm. Total polyphenols values were expressed in terms of gallic acid equivalent (GAE), which is a common reference compound.

**Dry matter content**

Dry matter content was analyzed by gravimetric method: samples had been dried to constant mass in a Venticell oven at (105 ± 5) °C and the loss of weight is used to calculate the dry matter content of the sample.

**RESULTS AND DISCUSSIONS**

**Ascorbic acid content in Rosa canina fruit**

Present study indicates that ascorbic acid content in *Rosa canina* fruit was found to be 720.42 mg/100 g dw in fresh whole fruit before freezing. Analysis of previous comparative studies shows great variability in ascorbic acid content of rose hips. For example, ascorbic acid content of various species of *Rosa* sp. from different northeastern regions of Romania was found to be between 614.54 and 866.91 mg/100 g fw (Rosu et al., 2011). Also, analyzing several *Rosa canina* L. genotypes from different districts of Romania Gheorghita et al. (2012) reported amounts of vitamin C in fresh hips ranging between 74 mg/100 g fw and 340 mg/100 g fw.

In the same time in different agroclimatic regions of Turkey ascorbic acid content analyzed in *Rosa* sp. fruit ranged between 106 and 2712 mg/100 g fw (Demir and Ozcan, 2001; Ercisli, 2007; Yoruk et al. 2008; Nojavan et al., 2008; Kazas et al., 2009). Comparatively, Saeed et al. (2008) found only 417 mg ascorbic acid/100 g fw in the fully ripe *Rosa canina* fruit in Iran. For East-European Region, studies on rose hips have revealed a vitamin C content in a range of 629-967 mg/100 g (Halasova and Jicinska, 1988) and 211-417.5 mg/100 g (Nojavan et al., 2008) in *Rosa canina* L. fruit. The differences in ascorbic acid contents reported by numerous authors could be due of variations in altitude, species, variety, ecological factors and harvest time.

Storage of *R. canina* fruit in frozen state determined a slight decrease in the ascorbic acid amount during the experiment period (17.5% after six months of storage) (Figure 1).

![Figure 1. Ascorbic acid content in the analyzed variants](image)

Investigation of the ascorbic acid in the frozen pulp of eight forms of *Rosa canina* biotypes from Transylvania noticed a variation of the obtained values between 112.20 mg/100 g and 360.22 mg/100 g frozen pulp (Roman et al., 2013).

A lower ascorbic acid content in *R. canina* (527.17 mg/100 g dw in whole dry fruit) was measured when drying the fruit comparing to fresh fruit. It is well known that processing treatments affects water-soluble nutrients such as vitamin C, making it susceptible to loss due its sensitivity to heat, light and oxygen (Balan et al., 2016).
Also the preparation method of dried fruit affected the stability of ascorbic acid during storage. Whole dried fruit showed a 27.74% decreasing of the ascorbic acid amount after six months, while powder state storage determined a higher reduction (48.55%) (Figure 1).

**Total carotenoids content in Rosa canina fruit**

Analysis performed in these study revealed important amount of total carotenoids content in fresh fruit before freezing (52.46 mg/100 g dw), which are in according with the results reported by other studies conducted in Romania. So, Rosa canina L. fruit from the spontaneous flora in Suceava district registered amounts between 9.37-62.47 mg/100 g dw (Ropciuc, 2011). Investigating different Rosa sp. from the northeastern region of Romania amounts of total carotenoids were found in a range of 34.95 mg/100 g fw (in Rosa subcanina) to 24.64 mg/100 g fw (in Rosa nitidula) (Rosu et al., 2011).

Frozen fruits registered a 9.55 % decrease of carotenoids amount at the end of the storage period (after six months).

Analysis of the whole dry fruits showed lower content of total carotenoids (45.11 mg/100 g dw), indicating a decrease with 14.01% compared to the fresh fruit. Preservation of Rosa canina fruit in dry state indicated higher losses in carotenoids content depending on preparation variant: 19.02 % in whole dried fruit and 27.6 % in powder dried fruit (Figure 2).

Mihaylova et al. (2015) have been investigated two types of commercial tea and also found differences between carotenoids amounts determined in whole fruit and in the powder of R. canina from paper bags.

**Total polyphenols content in Rosa canina fruit**

Present study indicates important amount of total polyphenols content in fresh Rosa canina fruit before freezing (520.42 mg GAE/100 g dw) and similar values in dry whole fruit (515.72 mg GAE/100 g dw) and dry powder fruit (515.28 mg GAE/100 g dw). These data are in agreement with some literature data such as: Nowak et al. (2007), who obtained 990 mg GAE/100g dry plant and Yoo et al. (2008) who reported 818 mg GAE/100g fresh fruit. Lower concentration of total phenolic content in Rosa canina fruit were reported by Duda-Chodak et al. (2011) (110 mg/100g dry fruits) and by Yilmaz et al. (2011) (102 mg/100 g dry fruits).

At the end of the storage period the total polyphenols content measured in the whole frozen fruits was 495.29 mg GAE/100 g dw, so six months of frozen storage did not significantly affect the total polyphenols content in the whole fruit, which registered only a 4.83% decrease (Figure 3).

Also Roman et al. (2013) analyzing eight forms of Rosa canina L. from Transylvania in order to estimate the possibility of rose hips fruit using in food found for the amount of total polyphenols content values between 575.0 mg GAE/100 g and 326.5 mg GAE/100 g for in frozen pulp depending of the culture area. Determinations made in the whole dry fruits showed a higher decrease (6.86%) of the polyphenols content compared to the one registered in frozen state at the end of the storage period.

The polyphenols amounts registered after six months of storage in the dry fruit showed similar values either whole (480.32 mg...
GAE/100 g dw) or powder state (478.35 mg GAE/100 g dw) (Figure 3).

CONCLUSIONS

The amount of ascorbic acid, total carotenoids and total polyphenols determined in *Rosa canina* L. fruit decreased after six months in all the analyzed variants regardless of the storage conditions, but the polyphenols have proven to be more stable than the other analyzed compounds. However, the antioxidants analyzed in this study have shown better storage capacity of *Rosa canina* L. fruit in frozen condition compared to dry one. Although the fruit storage in frozen condition proved better results considering preservations of the antioxidants content, usually storage in dry condition being more common.

The preparation method of dried fruit influenced stability of ascorbic acid, total carotenoids and total polyphenols: whole dry fruit showed a better retention of the antioxidants content compared to the powder dry fruit. Considering these results it can be said that is more convenient to use whole dry fruits rather than powder dry fruits in order to obtain better commercial tea products.

Rose hips from *Rosa canina* L. can be also use as a natural food additive in order to improve the preservation of some foodstuffs due to the high antioxidants stability noticed in the analyzed samples.

REFERENCES


***STAS 13058-91 Produse din legume si fructe. Determinarea carotenului.