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Several Fruit Characteristics of *Rosa* sp. Genotypes from the Northeastern Region of Romania

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Abstract

There is great evidence regarding the beneficial influence of rose hips on human and animal health. In this respect, fruits of native populations of *Rosa* spp. collected from the northeastern part of Romania (400-1060 m altitude) were assayed for nutritional and some morphological properties, in order to select the best genotypes. The results show a great quantitative variability of analyzed genotypes, regarding dimensions and biochemical indicators as follow: ascorbic acid: 866.91 mg/100 g fw (*R. rubiginosa*), 615.98 mg/100 g fw (*R. caesia*); carotenes: 34.95 mg/100 g fw (*R. subcanina*), 24.64 mg/100 g fw (*R. nitidula*); protein content: 0.47 g/100 g fw (*R. micrantha*), 0.25 g/100 g fw (*R. caesia*); total sugars: 17.63 g/100 g fw (*R. andegavensis*), 11.55 g/100 g fw (*R. caryophyllacea*). The fruits length, width and dry weight were: 25 mm *(R. canina*), 12 mm (*R. micrantha*), 16.5 mm (*R. corymbifera*), 8 mm (*R. micrantha*) and 25% dry weight (*R. rubiginosa*), 38% dry weight (*R. nitidula*), respectively. The present study demonstrates the existence of a rich rose germplasm source in north-east area, with good biotechnological fruit quality, which recommends them as functional foods according to their chemical contents (*R. rubiginosa, R. vosagiaca, R. subcanina, R. canina* and *R. caryophyllacea*) and also as sources for natural colorants in food technology.

Keywords: ascorbic acid, carotenes, protein, rose hips, total sugars

Introduction

Rose hips are one of the richest fruits in vitamins (especially vitamin C) from Romania and can be found in the spontaneous flora in large quantities. These species hold a key position in the strategy of the sustainable culture and by their biotechnological valences they can offer valuable solutions to the economic, social and environmental problems. Some of the desirable qualities of fresh or preserved rose hips are; elevated levels of vitamin C, carotenes, sugar and dry weight, which recommends them as functional food and could justify the exploitation of these very rich natural sources of vitamins, based on their benefit to human health. From this point of view, documented studies exist, related with the effect of rose hips on reducing the risk of cardiovascular diseases (Ninomya *et al*., 2007) or different form of cancer (Karakaya and Kavas, 1999; Omenn *et al*., 1996; Olsson *et al*., 2004). Also, consumption of fresh or preserved rose hips induces an anti-inflammatory effect (Deliorman *et al.,* 2007; Winter *et al*., 2005).

The great nutritive and medicinal value of native populations of *Rosa* spp. are derived mainly from their chemical composition in sugars, proteins, lipids, tannins, pectin, organic acids, amino acids, essential oils and minerals (Celik *et al*., 2009; Chai and Ding, 1995; Daels-Rakotoarison *et al.,* 2002; Erdurak-Kiliç *et al.,* 2005; Ercisli and Guleryuz, 2006; Hornero-Mendez and Minquez-Mosquera, 2000; Olsson *et al.,* 2005; Razungles *et al.,* 1989; Uglla *et al*., 2003).

Within Romanian flora there are known 29 spontaneous and subspontaneous species, and also 5 hybrids of *Rosa* L. genus. From those 29 species, only 16 were identified in the northeastern part of Romania (Oprea, 2005). Therefore, the proposed research focused towards selection of germplasm sources in the Northeast area of Romania, which has a high content in bioactive principles.

Materials and methods

Sample collection and processing

Samples of *Rosa* spp. were collected from altitudes between 400-1060 m, from the northeastern region of Romania. According to taxonomic criteria (Buia and Prodan, 1956; Ciocarlan, 2000; Klášterský, 1968; Oprea, 2005) 10 species were identified as follows: *Rosa canina* L. S. Str., *R. subcanina* (Christ) Vuk., *R. corymbifera* Borkh., *R. nitidula* Besser, *R. vosagiaca* N.H.F. Desp., *R. caesia* Sm., *R. caryophyllacea* Besser, *R. micrantha* Sm., *R. rubiginosa* L. and *R. andegavensis* Bastard.

The fruits were harvested at the fully ripe mature stage (late September and October) for two years consecutively and stored at 4°C till processing. For each genotype and

collecting year, the average samples (3 replicates) were randomly chosen from 100 fruits, mixed in a blender and analyzed for the ascorbic acid, carotenes, total sugar, protein level and dry weight. The results were expressed as the two year average (± SE) of a total of six selected replicates for each genotype of *Rosa* spp. (33 fruits/replicates).The total replicates number depends on number of analyzed genotypes.

Biometrical data

Fruit width (mm) and length (mm) measurements were done on 100 fruits for each genotype.

Assay of ascorbic acid content

The ascorbic acid content was estimated with 2, 6-dichlorophenol indophenol solution (Artenie and Tanase, 1981). Results were expressed as mg of ascorbic acid per 100 g fresh weight.

Assay of carotene content

Fruits (0.2-0.3 g) were homogenized with a mixture of anhydrous sodium sulphate and calcium oxide, to retain water and colored compounds, except carotenes (Artenie and Tanase, 1981). Also, anhydrous sodium carbonate was added to prevent carotene decomposition in an acid medium. The homogenized fresh samples were then extracted with acetone and petroleum ether. The absorbance of the extracts was measured at 450 nm using a spectrophotometer (UV-1700 PharmaSpec., Shimadzu, Japan) The carotene content was expressed as mg carotene per 100 g fresh weight.

Assay of total sugar content

The total sugars in rose hips (0.3 g) were determined as total reducing sugars using 3, 5-dinitrosalycilic acid method (Miller, 2002). Absorbances of the samples and the standard (30-300 µg/ml glucose solution) were measured at 500 nm with a spectrophotometer (UV-1700 PharmaSpec Shimadzu) using distilled water as blank. The total sugar concentration of the samples was expressed as g glucose per 100 g fresh weight

Assay of soluble protein content

The soluble protein content in fruit samples was determined according to the Bradford (1976) procedure. The results were expressed as g protein per 100 g fresh weight.

Dry weight

The dry weight of the fruit flesh was gravimetrically determined after drying the fruits at 105°C to constant weight. The percent of dry weight in samples was calculated according to Boldor (1983).

Results and discussion

Ascorbic acid content

The data presented, as a preliminary study on nutritional value of rose hip from the northeastern region of Romania, shows that a high level of vitamin C content exists with maximum values of 866.91 mg/100g fw (*Rosa rubiginosa*) and 816.77 mg/100 g fw (*Rosa vosagiaca*) (Tab. 1). The lowest value (615 mg/100 g fw) was assayed in *Rosa caesia*. In analyzed samples, ascorbic acid contents varied more with the genotype and not with the altitude (Fig. 1). A great content variability was noted between the genotypes.

In the previous comparative studies, a great variability in vitamin C content of rose hips was also found. For example, ascorbic acid content of various species of *Rosa* from different regions of Turkey ranged between 106 and 2712 mg/100 g fw (Demir and Ozcan, 2001; Ercisli and Esitken, 2004; Ercisli, 2007; Kazaz *et al.,* 2009; Yoruk *et al*., 2008).

Comparatively, Saeed *et al.* (2008) found only 417 mg ascorbic acid/100 g fw in the fully ripe *Rosa canina* fruits in Iran. For East-European Region, studies on rose hips have revealed a vitamin C content in a range of 629-967

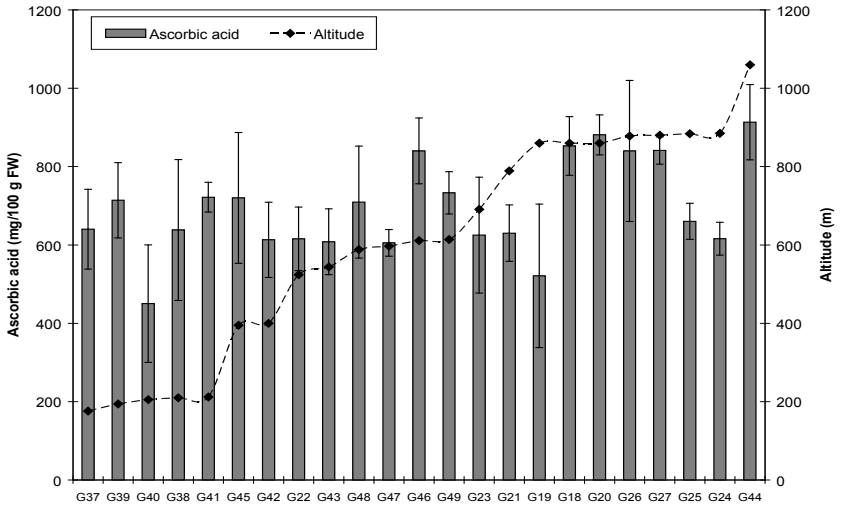

Fig. 1. Ascorbic acid content of *Rosa* sp. L. fruits at different genotypes and altitudes

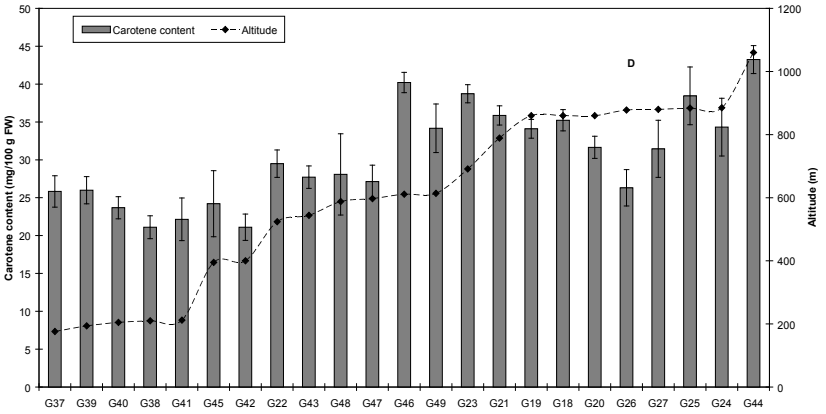

Fig. 2. Carotene content of *Rosa* sp. L. fruits at different genotypes and altitudes

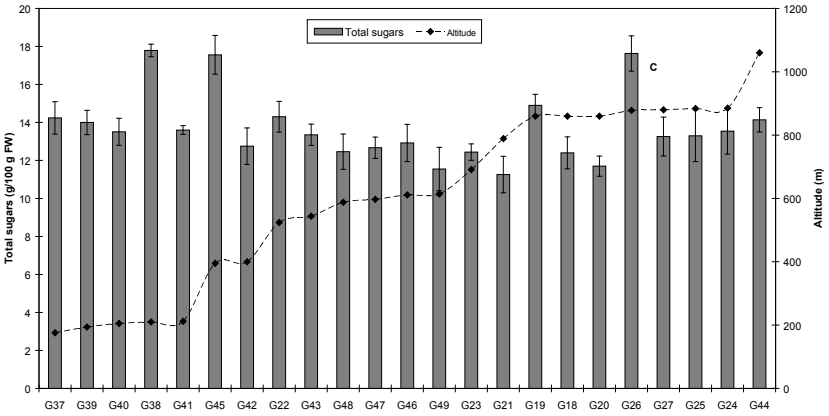

Fig. 3. Total sugars content of *Rosa* sp. L. fruits at different genotypes and altitudes

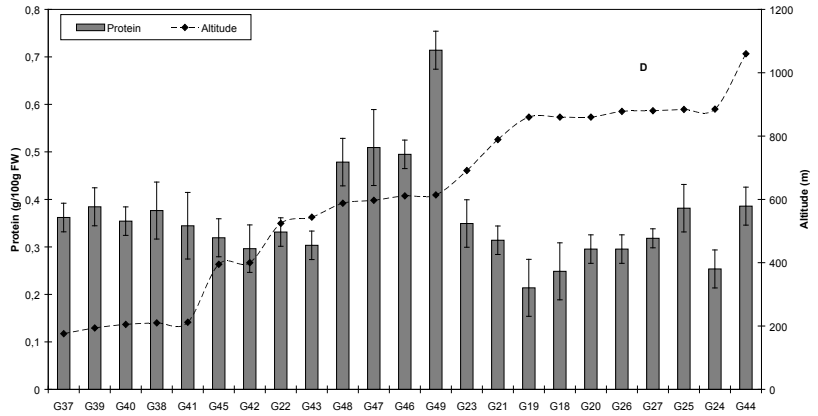

Fig. 4. Protein content of *Rosa* sp. L. fruits at different at different genotypes and altitudes

mg/100 g (Halasova and Jicinska, 1988) and 211-417.5 mg/100 g (Nojavan *et al.,* 2008) in *Rosa canina* L. fruits.

Carotene content

The investigated rose hips contained a carotene content in a range of 34.95 mg/100 g fw (*Rosa subcanina* (Christ) Vuk.) to 24.64 mg/100 g fw (*Rosa nitidula).* For this indicator, the higher values were determined in the fruits growing after 700 m altitude in Suceava and Neamt districts (Tab.1 and Fig. 2).

Andersson (2009) found that carotenes content correspond to 48% of total carotenoids in the red-colored rose hips.

A high content was found by Hornero-Mendez and Minquez-Mosquera (2000) of 497.6 mg/kg dw (β-carotene) and 391.9 mg / kg dw (lycopene). This is also in agreement with other reports (Gao *et al*., 2000; Olsson *et al.,* 2005). Olsson *et al.* (2004) concluded that rose hips have a high content of total carotenoids compared with other berries and small fruits.

Total sugar content

The total sugars content in the fruits of rose species was found to be in a range of 17.63 g/100 g fw (*Rosa andegavensis*) to12.05 g/100 g fw (*Rosa rubiginosa*) (Tab. 1 and Fig. 3).

Tab. 1. Nutritional value of *Rosa* sp. species identified in the northeastern region of Romania

Species	Ascorbic acid (mg/ 100 g fw)	Carotenes (mg/100 g fw)	Total sugars (g/100 g fw)	Protein (g/100 gfw)
R. rubiginosa L. (n= 12)*	866.91 ± 71.4**	33.44 ± 1.40	12.05 ± 0.84	0.27 ± 0.06
R. canina L. S. Str. *canina* (n=42)	643.38 ± 138.4	28.78 ± 2.07	13.28 ± 0.85	0.36 ± 0.03
R. subcanina (Christ) Vuk. (n= 12)	700.68 ± 35.7	34.95 ± 3.77	13.28 ± 1.02	0.35 ± 0.03
R. corymbifera Borkh. (n=24)	614.54 ± 120.11	31.45 ± 1.32	14.62 ± 0.33	0.30 ± 0.06
R. vosagiaca N.H.F. Desp. (n= 12)	816.77 ± 113.24	33.72 ± 8.45	15.85 ± 1.82	0.35 ± 0.03
R. andegavensis Bastard (n=6)	635.19 ± 45.25	26.31 ± 2.40	17.63 ± 0.93	0.29 ± 0.03
R. caesia Sm. (n= 6)	615.98 ± 96.43	34.32 ± 3.81	13.54 ± 1.36	0.25 ± 0.05
R. nitidula Besser (n=12)	663.57 ± 45.32	24.64 ± 2.82	13.13 ± 0.23	0.42 ± 0.08
R. micrantha Sm. (n=6)	709.34 ± 180.16	28.08 ± 5.36	12.46 ± 0.93	0.47 ± 0.05
R. caryophyllacea Besser (n=6)	733.18 ± 123.43	34.17 ± 3.20	11.55 ± 1.14	0.41 ± 0.04

*Number of replication; **The values are the means of the replications ± SD

The literature mentioned various contents in total sugars of fresh rose hips as follow: 13.34-17.14% total soluble carbohydrates in *Rosa canina* fruits (Saeidi and Beygi, 2009) or 18-28% (Uglla *et al.,* 2005), expressed as glucose, sucrose and other sugars in *Rosa* spp. fruits. The results from literature, in a large broad of limits, as in case of total carotenoid content, result from different degrees of ripeness of fruits.

Protein content

Rose hips are not a very rich sources of proteins. The quantified protein level in the samples was small, with low variations, between 0.25 g/100 g fw (*Rosa caesia*) and 0.47 g/100 g fw (*Rosa micrantha*) (Tab. 1 and Fig. 3).

Biometrical characteristics

The dimension of the fruits varied in a range of 24.0-13.6 mm length, from *Rosa canina* to *Rosa micrantha* and between 16.2-8.8 mm width from *Rosa corymbifera* to *Rosa micrantha.* In case of dry weight of the fruits, an indicator with biotechnological importance, the registered values are usually more than 30%. (Tab. 2).

The present results are in accordance with the literature in the field. For the Romanian topoclimateric conditions, some biometric characteristics of the rose hips has been noted (Buia and Prodan, 1956; Klášterský, 1968; Zanoschi in Zanoschi *et al*., 2000), as following:

• ***Rosa rubiginosa*** L.-hypanthium subglobose, ovoid or ellipsoid, 5-15 mm long.

Blossom: June-July.

Distribution in Romanian flora: sporadically, from plains to mountains.

• ***Rosa canina*** L. S. Str.-hypanthium globose, ovoid or ellipsoid, 15-20 mm long.

Blossom: May-June.

Distribution in Romanian flora: frequent, from plains to mountains, up to 1200 (-1700) m altitude.

• ***Rosa subcanina*** (Christ) Vuk. (*Rosa vosagiaca* subsp. *subcanina* (Christ) R. Keller)-hypanthium ovoid or globose, 10-20 mm long.

Blossom: May-June.

Distribution in Romanian flora: very rare, on plains.

• ***Rosa corymbifera*** Borkh. (*Rosa dumetorum* Thuill.)-hypanthium globose to ovoid, 15-20 mm.

Blossom: May-June.

Distribution in Romanian flora: relatively frequent, from plains up to mountains.

• ***Rosa vosagiaca*** N.H.F. Desp.-hypanthium globose (rarely ovoid), 15-20 mm long.

Blossom: May-June.

Distribution in Romanian flora: sporadically, from plains up to mountains.

• ***Rosa andegavensis*** Bastard-hypanthium globose to ellipsoid, 15-20 mm long.

Blossom: May-June.

Distribution in Romanian flora: very rare, on hills.

• ***Rosa caesia*** Sm. (*Rosa coriifolia* Fr.)-hypanthium globose to ovoid, the central one pyriform, up to 25 mm long.

Blossom: May-June.

Distribution in Romanian flora: sporadically, from plains to up mountains.

• ***Rosa nitidula*** Besser-hypanthium globose or ellipsoid, 15-20 mm long.

Blossom: May-June.

Distribution in Romanian flora: sporadically, on plains.

• ***Rosa micrantha*** Sm.-hypanthium globose or ellipsoid, 15-20 mm long.

Blossom: June.

Distribution in Romanian flora: sporadically, from plains up to mountains.

• ***Rosa caryophyllacea*** Besser-hypanthium subglobose to ellipsoid, 10 mm long.

Blossom: May-June.

Distribution in Romanian flora: sporadically, on hills.

The altitude, longitude and latitude of the growing area could have an influence upon the dimensions of the rose hips as following: length and width of fruits will be higher in the central areal of the growth than in marginal areas.

Tab. 2. Fruit's length (mm), width (mm) and dry weight (%) of some *Rosa* sp. genotypes

Genotype /Species	Altitude	District	Fruit length (mm)			Fruit width (mm)			Dry weight (%)
			Mean	Min.	Max.	Mean	Min.	Max.	
R. rubiginosa L.									
G18-R. rubiginosa L.	860	Neamt	17.7	13.8	22.6	13.2	10.6	16.6	28.47
G20-R. rubiginosa L.	860	Neamt	19.9	15.1	24.9	12.1	9.8	14.3	32.08
R. canina L. S. Str.									
G21-R. canina L. S. Str.	789	Neamt	16.8	11.8	21.8	13.0	9.6	17.5	27.53
G22-R. canina L. S. Str.	524	Neamt	20.7	14.9	26.1	14.8	11.9	17.3	31.85
G37-R. canina L. S. Str.	176	Botosani	17.1	12.6	21.2	12.4	8.9	14.9	49.90
G39-R. canina L. S. Str.	194	Botosani	19.8	11.4	29.0	13.7	11.5	16.3	42.91
G40-R. canina L. S. Str.	205	Botosani	21.6	15.4	27.6	11.7	9.3	19.9	38.00
G42-R. canina L. S. Str.	400	Iasi	24.0	17.8	30.9	14.8	11.7	18.8	34.71
G46-R. canina L. S. Str.	611	Suceava	20.6	15.6	25.0	11.4	9.0	14.2	28.34
R. subcanina (Christ) Vuk.									
G25-R. subcanina (Christ) Vuk.	884	Suceava	19.3	15.6	22.1	12.8	9.6	14.9	32.93
G27-R. subcanina (Christ) Vuk.	880	Suceava	22.0	15.4	27.7	14.1	11.4	17.5	33.00
R. corymbifera Borkh.									
G19-R. corymbifera Borkh.	860	Neamt	19.6	14.4	23.2	10.7	9.3	12.3	31.09
G23-R. corymbifera Borkh.	691	Suceava	16.1	11.7	21.6	14.3	11.8	18.8	37.22
G28-R. corymbifera Borkh.	770	Suceava	15.4	12.3	18.0	12.0	10.0	14.0	33.45
G38-R. corymbifera Borkh.	210	Botosani	21.5	12.8	28.2	15.7	12.0	18.6	38.87
G43-R. corymbifera Borkh.	544	Suceava	19.8	13.8	24.6	16.2	12.8	21.6	36.76
R. vosagiaca N.H.F. Desp.									
G44-R. vosagiaca N.H.F. Desp.	1060	Suceava	18.0	14.0	21.7	12.3	9.9	15.0	32.59
G45-R. vosagiaca N.H.F. Desp.	395	Iasi	23.0	16.9	28.2	12.5	10.0	15.3	33.28
R. andegavensis Bastard									
G26-R. andegavensis Bastard	878	Suceava	18.9	13.2	24.3	14.2	10.9	17.8	31.76
R. caesia Sm.									
G24-R. caesia Sm.	885	Suceava	19.6	15.2	25.0	16.1	13.5	19.3	29.33
R. nitidula Besser									
G41-R. nitidula Besser	212	Botosani	17.7	13.6	22.0	13.0	11.0	17.9	44.80
G47-R. nitidula Besser	597	Suceava	18.2	12.7	23.7	11.6	7.7	13.7	42.12
R. micrantha Sm.									
G48-R. micrantha Sm.	588	Suceava	13.6	11.1	17.0	8.8	6.9	11.4	40.22
R. caryophyllacea Besser									
G49-*R. caryophyllacea* Besser	614	Suceava	12.6	9.4	16.0	13.0	10.6	15.2	37.34

To conclude, the relevance of the biometric studies on the rose hips of various genotypes of *Rosa* spp. is only partially and always in concordance with the local conditions for the analyzed genotypes.

Conclusions

The present study of nutritional and biometric parameters of rose hips identified in the northeastern regions of Romania revealed the presence of very good natural sources of vitamin C, total sugars and carotene, which varies mostly with genotype and analyzed species. Only the carotene content appears to be positively correlated with altitude.

Due to a considerable variation in moisture levels of fruits, important quantitative differences of analyzed indicators have been noted, between genotypes, based on fresh weight comparison.

The best sources for the active components are *Rosa rubiginosa* L., *R. subcanina* (Christ) Vuk. and *R. vosagiaca* N.H.F. Desp., collected from Neamt and Suceava districts (> 800 m altitude).

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