

## Phytochemical diversity of *Rosa canina* L. populations in Croatia

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### Introduction

*Rosa canina* L., also called dog rose or rosehip, is a perennial shrub of the Rosaceae family. It is native to Europe, Central Asia, and parts of the North Africa (Jürgens et al., 2007). In its natural range, which includes Croatia, dog rose is a well-known plant species with a rich and documented historical background and a long tradition of use as an important food source and medicine. Consumption of wild *R. canina* fruits is common in many European countries and is considered a natural remedy in the treatment of colds, coughs, and flu, as well as gastrointestinal disorders (Sen et al., 1996). A variety of pharmacological and nutritional effects have been scientifically proven for rosehip and its products (Chrubasik et al., 2008; Fan et al., 2014), and associated with the specific chemical composition and characteristic phytochemicals such as phenolics, carotenoids, unsaturated fatty acids, and high concentrations of vitamins (especially vitamin C) (Winther et al., 2016).

Previous studies have shown that bioactive compounds are prone to qualitative and quantitative variation depending on numerous factors, such as plant genotype, maturity stage, and the environmental conditions (Koczka et al., 2018; Yang et al., 2018).

In Croatia, rosehip is a widespread plant species that occurs in all three geographical regions (continental, alpine and Mediterranean). Our aim was to investigate the diversity of *R. canina* populations sampled in different geographical regions, in terms of content of main phytochemicals (vitamin C, total polyphenols, flavonoids, carotenoids) and antioxidant capacity.

### Materials and methods

For this study, a total of 12 *R. canina* populations, were collected from different geographical regions of Croatia; three populations (P01 - P03) were sampled in the northern parts of Croatia, population P04 in the eastern part of Croatia, four populations in central Croatia (P05 - P07), one population (P09) in the Istrian peninsula and three populations in the southernmost region of Croatia - Dalmatia (P10 - P12).

Vitamin C content (mg/100 g FW), total phenolic content (TPC; mg GAE/100 g FW), including flavonoids (TFC) and non-flavonoids (TNFC),  $\beta$ -carotene (mg/100 g FW) and lycopene content (mg/1g FW), and antioxidant capacity ( $\mu$ mol TE/L) of the samples were evaluated using standard laboratory methods, as described in Šic Žlabur et al. (2020). All experiments were performed in triplicate. To determine the differences between populations the obtained data were subjected to one-way analysis of variance using PROC GLM in SAS software (SAS Institute, 2004), followed by *post-hoc* Tukey's test.

### Results and discussion

Significant differences ( $P < 0.0001$ ) between populations were confirmed for all parameters. Vitamin C content was characterized with extremely high variability ( $CV = 46.62\%$ ). The average vitamin C content across all samples was 118.10 mg/100 g FW and ranged from 33.05 to 200.59 mg/100 g FW at the individual level. At the population level, the average vitamin C content ranged from 35.44 mg/100 g FW in P12 (Mediterranean region) to

the significantly highest value of 198.66 mg/100 g FW in P04, the population from eastern Croatia, followed by P01 (189.39 mg/100 g FW) and P08 (187.50 mg/100 g FW). In general, populations from the northern, central, and eastern regions of Croatia tended to have higher vitamin C content when compared to Mediterranean populations. The wide variability in vitamin C content is evident from numerous studies, that reported different ranges; Novajan et al. (2008) reported a range of 211 to 417.5 mg/100 g fresh pulp, Bozhuyuk et al. (2021) found 430 to 690 mg vit. C/100 g FW, while Türkben et al. (2010) found 43.77 mg in 100 g FW. *R. canina* is known for its high concentrations of phenolic compounds, which are potent antioxidant phytochemicals synthesized in response to various abiotic and biotic stresses (Dai et al., 2011). An intermediate variation in TPC, TNFC, and TFC was observed among the populations ( $CV = 16.25\% - 17.96\%$ ). The average TPC across all populations was 950.60 mg GAE/100 g. The significantly highest average TPC and TNFC was found in population P05 from central Croatia (1266.25 mg GAE/100 g and 379.67 mg GAE/100 g, respectively), followed by P07 (TPC = 1131.88 mg GAE/100 g), however, a clear dominance of total flavonoids over non-flavonoids was observed in this population (608.50 mg GAE/100 g vs. 523.38 mg GAE/100 g). The Mediterranean population P11 had the significantly lowest values for TPC, TNFC, and TFC. Two plant pigments from the carotenoid group were identified:  $\beta$ -carotene and lycopene, and both parameters were highly variable and did not show a clear pattern. The average  $\beta$ -carotene content was significantly highest in P04 from eastern Croatia (36.17 mg/100 g FW) followed by significantly lower values in P08 (30.08 mg/100 g FW). The significantly highest lycopene content was found in P02 (23.54 mg/g). In the Mediterranean population P11, the significantly lowest values for both  $\beta$ -carotene and lycopene content were found, 2.16 mg/100 g FW and 6.59 mg/g, respectively. The antioxidant capacity of a species is related to the high content of bioactive compounds such as vitamins, polyphenols, carotenoids, etc., of which *R. canina* is a valuable source (Koczka et al. 2018). The variation of antioxidant capacity between the studied samples was low ( $CV = 1.53$ ). The highest average values of 2540.31  $\mu\text{mol TE/L}$  were found in P04, the population with the highest  $\beta$ -carotene content, and slightly lower values but nonsignificant were found in P01, P08, P11, and P12.

## Conclusion

The overall results show quantitative variability in bioactive compounds and high nutritional and functional

value of some *R. canina* populations. Further studies should focus on detailed analysis of populations from the wider distribution area in Croatia and more detailed qualitative and quantitative chemical analysis of individual bioactive compounds.

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