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Salidroside content in *Rhodiola rosea* L., dynamics and variability

Mariam Bozhilova

Institute of Botany, Bulgarian Academy of Science, "Acad. G. Bonchev" street, bl.23, 1113 Sofia, Bulgaria

ABSTRACT: The aim of this study was to investigate the dynamics of the salidroside content in the underground parts of *Rhodiola rosea* L. during two consecutive vegetation periods and its variability. The obtained annual trends of the salidroside content expressed similar pattern for both years and for both kinds of the investigated matherials (roots and rhizomes) of each sex. The signifficant influence on the content of salidroside exert the sex, plant part and season.

Key words: *Rhodiola rosea* L., salidroside, variation, dynamics.

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INTRODUCTION

Rhodiola rosea L. (*Crassulaceae*) is a rare species for the Bulgarian flora, protected by the Low of Biodiversity (2002) and prohibited for collection. It has many health benefits: adaptogenic properties (Kelly 2001), effects on memory and learning (Shevtsov *et al.* 2003), cardio protective effect (Maslova 2004), antioxidant properties (Pooja *et al.* 2006) and effect in cancer therapy (Agnieszka *et al.* 2006).

R. rosea is highly variable in phytochemical aspect (Kurkin *et al.* 1988, Wiedenfeld *et al.* 2007). In our previous study we established that the salidroside content is geneticaly determinated and retained in the generation obtained by vegetative propagation (Bozhilova 2009).

The dynamics of the salidroside content has been studied (Kim 1976, Surov *et al.* 1981, Saratikov & Krasnov 1987, Nekratova *et al.* 1992), but the obtained results are discrepant. A possible reason for this is the random sampling. When using it, the obtained differences between the phenological phases could be not due to real dynamics, but to geneticaly determinated differences between the samples, analysed in each period. To avoid the influence of such accidental factors its nessesery to investigate the dynamics on clones.

The aim of this study was to investigate the dynamics of the salidroside content during the vegetation period and its variability.

MATERIAL AND METHODS

The dynamics of the salidroside content was retraced in fifteen clones of *R. rosea*. The plant material was collected during the vegetation periods of 2007 and 2008 (respectively two and three year old specimens), six times each year, in different phoenological phases from the experimental field of the Institute of Botany, BAS, situated in the Rhodopi Mountains (41°50′57′′N, 24°07′08′′E, 1525m asl).

The roots and the rhizomes were separated, dried at 30°C in a heated drying house and powdered. The content of salidroside was determined thrice for each sample and averaged. The analysis was made according to the USSR State Pharmacopoeia (1990). The absorption was measured at a Specol 10 spectrophotometer.

The statistical analysis was made with Excel 2003. The significance of the differences is assessed by t-tests. The degree of variation was estimated by the variation coefficient (CV, %) according to a 5-degree scale (Mamaev 1968) (below 7% - very low, 7.1-12% - low, 12.1-20% - medium, 20.1-40% high, above 40.1% - very high variation).

*correspondence: maniraffi@yahoo.com

RESULTS

The obtained annual trends of the salidroside content (Fig. 1) are similar for the both studied years and for both kinds of the investigated matherials (roots and rhizomes) in each sex. In the male samples' trends there are two maximums – one in the beginning and one in the end of the vegetation period, and a marked minimum directly after the end of blossoming. The first maximum and the minimum in the female samples' trends coincide with the males', but the second maximum is displaced earlier, in phase of fruit fall.

Trends in 2007. The salidroside content in the male roots varied in the following limits (0.67)-1.14±0.25-(1.56)% for the first maximum, (0.45)-0.64±0.10-(0.75)% for the minimum and (0.92)-1.15±0.29-(1.71)% for the second maximum. The variation between the clones was high in the periods with maximal salidroside content (21.97% and 25.50%) and medium in the period with minimum salidroside (15.11%). [the order is presented by the following pattern: (minimum) average±standard deviation (maximum)]

In the male rhizomes the salidroside content was (1.21)-1.58±0.27-(2.12)% and (1.09)-1.40±0.29-(2.17)% in the periods with maximum salidroside content and (0.83)-0.95±0.80-(1.10)% in the period with minimal values of the investigated substance. The variation coefficients for the discussed periods were 20.17, 25.65 and 9.76%, respectively.

The salidroside content in the female roots during the first maximum varied in the limits (0.48)-0.80±0.20-(1.15)%. The values in the period with minimal salidroside content were (0.42)-0.56±0.11-(0.69)%. In the subsequent period, the values increased reaching the limits (0.53)-0.83±0.23-(1.17)%.

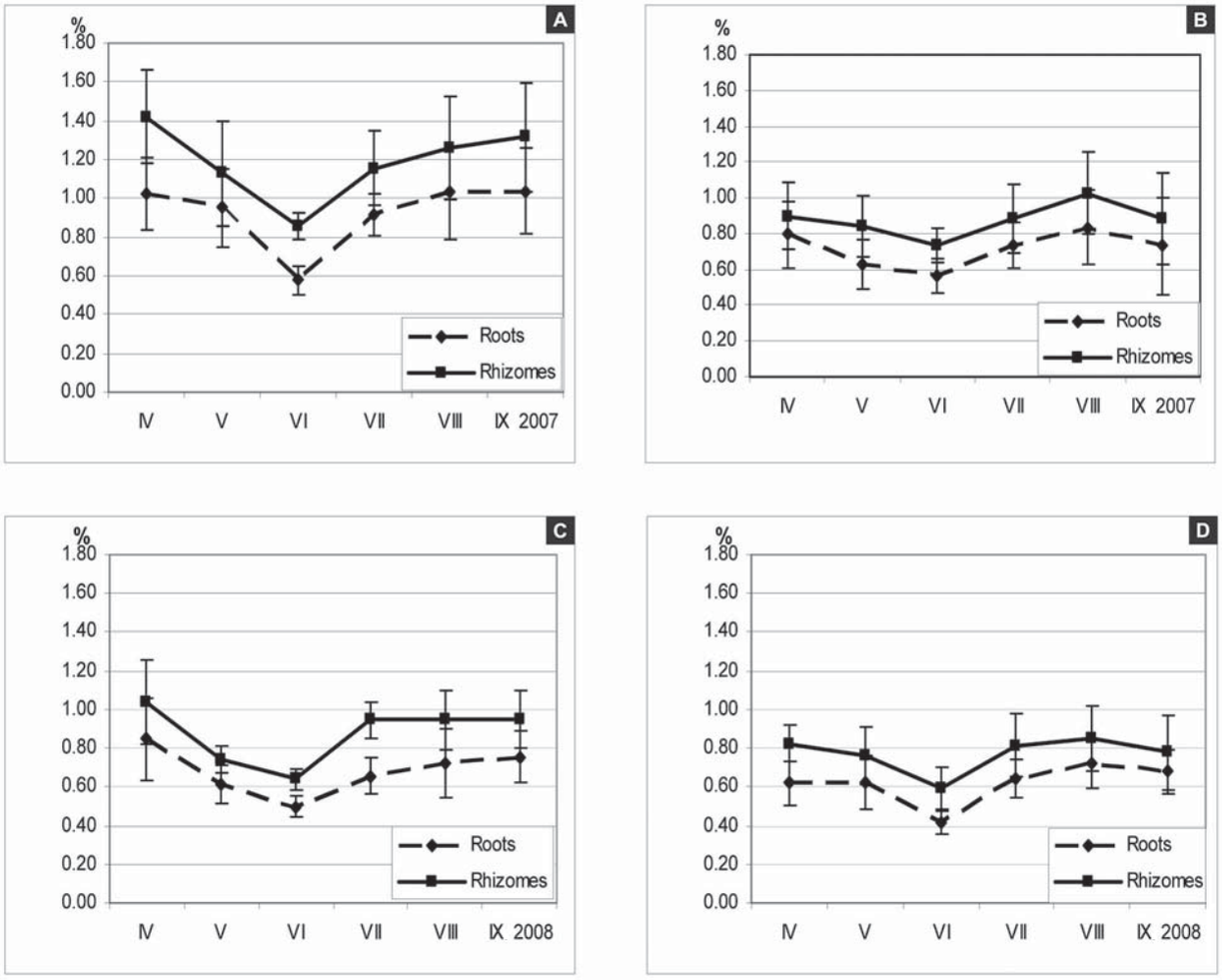

Fig. 1. Salidroside content (%) in the investigated samples (average values and 95% confidence levels): A – male samples 2007, B – female samples 2007, C – male samples 2008, D – female samples 2008; Male samples: IV – beginning of vegetation, V – butonization, VI – end of blossoming, VII – IX – autumn vegetation. Female samples: IV – beginning of vegetation, V – butonization, VI – end of blossoming, beginning of fructification, VII – fructification, VIII – fruit fall, IX – autumn vegetation.

The coefficients of variation were in the highest limits in the periods with maximal salidroside content (25.23% and 27.19%) and the medium value was recorded in the period with minimal content (18.89%).

In the female rhizomes the salidroside content in the first maximum amounts to (0.65)-0.90±0.20-(1.26)%. It fall down to (0.55)-0.74±0.10-(0.88)% in the period of the minimum content, and ascends to (0.76)-1.02±0.25-(1.33)% during the second maximum content period. The variation between the samples is high in the periods of maximum salidroside content (22.51% and 23.99%) and medium value in the period of the minimum content (14.07%).

Trends in 2008. In the second year of the investigation the salidroside content in the male roots varied in the frame (0.64)-0.85±0.26-(1.32)% for the first maximum, (0.46)-0.50±0.07-(0.6)% for the minimum and (0.56)-0.75±0.16-(1.00)% for the second period with maximum salidroside content. The variation is high in the both periods of maximum 30.38% 21.37% respectively, and medium value in the period with lower salidroside content - 13.58%.

The content of the investigated substance in the male rhizomes is (0.78)-1.04±0.27-(1.59)% in the period of the first maximum, (0.54)-0.64±0.06-(0.72)% in the period with minimal salidroside content and (0.72)-0.95±0.18-(1.30)% it the period of the second maximum content.

The female roots contained (0.39)-0.62±0.12-(0.72)% salidroside in the period of the first maximum, (0.34)-0.42±0.07-(0.54)% in the minimum and (0.46)-0.72±0.14-(0.89)% in the period of the second maximum. The variation was medium (19.74%, 18.46%, 16.45%).

In the female rhizomes, the salidroside content amounts was (0.71)-0.82±0.10-(1.00)% in the beginning of vegetation. It decreased (0.44)-0.59±0.12-(0.74)% in the period with minimum salidroside content, and raised up to (0.52)-0.85±0.18-(1.04)% in the second maximum. The variation vales were medium in the periods of the first maximum and the minimum (12.54% and 19.62% respectively) and high in the period of the second maximum (20.39%).

DISSCUSION

The dynamics of the salidroside content is related to the stages of the development of the aboveground phytomass. That is the reason for the existing differences between the both sexes. These differences are probably due to the different character of the growth development in the male and female plants. The males stop growing in the end of the blossoming. Females continue their growth till the end of the vegetation period. Besides, the secondary blossoming is more frequent for the female plants (Polozhnii 1976).

In the second year of the investigation there was a significant reduction of the saldroside content in the both sexes. For the male samples this reduction was with 25.7% for the roots and with 27.9% for the rhizomes. For the female ones the reduction was lower. The salidroside in the roots decreased with 13.7%, and in the rhizomes with 13.5%. In culture the salidroside content decreased in the third year because of the intensive growth of the plants (Kim 1976, Saratikov & Krasnov 1987).

In general, the male individuals possess higher salidroside content than the female ones. The same regularity was noted by Platikanov & Evstatieva (2008).

This diferense was more pronounsed in the first year with amounts up to 23% for the roots and 25% for the rhizomes. In the second year, when the salidroside content of the male samples decreased in a higher degree, and was not significant with amounts up 9% for the both kinds investigated plant parts.

A significant difference was established between the roots‘ and the rhizomes‘ salidroside content. This difference appeared in both sexes and in both years of the researche. For the male samples, averaged for the vegetation period 2007 the roots contain 24% less salidroside than the rhisomes. In the female samples, this difference was about 21%. In the second year, the difference was equal for both sexes 21%.

The salidroside contents in the investigated samples in the periods of its maximum exceeded the pharmacopoeia requirement for minimum of 0.8% salidroside. The female roots made an exceptions in the second year.

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REFERENCES

Agnieszka M, Hoser G, . Furmanowa M, Urbanska N, Pietrosiuk A, Zobel A & Mieczyslaw K. 2006. Antiproliferative and antimitotic effect, S phase accumulation and induction of apoptosis and necrosis after treatment of extract from *Rhodiola rosea* rhizomes on HL-60 cells. *J. Ethnopharmacology* **103**: 43–52.

Bozhilova M. 2009. *Rhodiola rosea* L. – morphology and salidroside content. Proceedings of the Seminar of ecology 2009, Bulgaria. Pp. 49-55.

Kelly GS. 2001. *Rhodiola rosea*: a possible plant adaptogen. *Alternative Med. Rev.* **6**: 293-302.

Kim EF. 1976. An attempt for growing golden root in the low mountains of Altai. *Plant resourses* **12**(4): 583-590. (in Russian)

Kurkin VA, Zapesochnaia GG, Nuhimovskii EL & Klimahin GI. 1988. Chemical composition of rhizomes of Mongolian *Rhodiola rosea* L. population introduced near Moscow. *Chem. Pharm. Journal* **22**(3): 324-326.

Mamaev S. 1968. For the patterns of fluctuation in the amplitude of signs variability in populations of higher plants. *General biology* **4**(29): 413-427 (in Russian).

Maslova LV, Kondratev BU, Maslov LN & Lishmanov UB. 2004. The cardioprotective activity of an extract of *Rhodiola rosea* in stress. *Medicina* (Kaunas) **40**(7): 614-619.

Nekratova NA, Krasnov EA, Nekratov IF & Mihailova SI. 1992. Changes in the quantity of salidroside and tannins in the underground parts of *Rhodiola rosea* L. in natural habitats in Altai. *Plant resourses* **4**: 40-48 (in Russian).

Platikanov S & Evstatieva L. 2008. Introduction of wild golden root (*Rhodiola rosea* L.) as a potential economic crop in Bulgaria. *Econ. Bot.* **62**(4): 621-627.

Polozhnii AV & Reviakina NV. 1976. Biology of development of the golden root in the region of Katun ridge (Altai). *Plant resources* **1**(12): 53-59 (in Russian).

Pooja K, Anilacumar R, Khanum F & Bawa A. 2006. Phytoconstituents and antioxsidant potency of *Rhodiola rosea* – a versatile adaptogen. *J. Food Biochem.* **30**: 203–214.

Saratikov A & Krasnov E. 1987. Golden root-a valuable medicinal plant. Tomsk State University Publishing House, Tomsk. (in Russian).

Shevtsov VA, Zholus BL, Shervarly VL, Volskij VB, Korovin YP, Khristich MP, Roslyakova NA & Wikman G. 2003. A randomized trail of two different doses of a SHR-5 *Rhodiola rosea* extract versus placebo and control of capacity of mental work. *Phytomedicine* **10**(2-3): 95-105.

Surov UP, Saharanova NA & Sutormina NV. 1981. Medicinal and fruit plant resources in Upper Altai. Tomsk State University Publishing House, Tomsk. (in Russian).

USSR State Pharmacopoeia 1990. XI Ed. Vol.2 Medicina, M., pp. 364-366. (in Russian).

Wiedenfeld H, Dumma M, Malinowski M, Furmarowa M & Narantuya S. 2007. Phytochemical and analytical studies of extracts from *Rhodiola rosea* and *Rhodiola quadrifida*. *Pharmazie* **62**: 308-311.

REZIME

Dinamika i varijabilnost sadržaja siderozida kod *Rhodiola rosea* L.

Mariam Bozhilova

Cilj ovog istraživanja bio je utvrđivanje dinamike i varijabilnosti sadržaja salidrozida u podzemnim delovima biljke *Rhodiola rosea* tokom dve uzastopne vegetacijske sezone. Sadržaj salidrozida je imao sličnu godišnju dinamiku i u rizomima i u korenovima kod primeraka oba pola ove biljke. Konstatovano je da na sadržaj salidrozida utiču pol i određeni deo biljke, kao i sezona.

Ključne reči: *Rhodiola rosea* L., salidrozid, varijacija, dinamika