The effect of *Rhodiola rosea* extracts on the bacterial infection in mice

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Abstract

The effect of feeding mice R. rosea extracts on Pseudomonas aeruginosa infection was studied. It was found that the infection intensity was highly significantly lower after treatment of mice for 7 days with daily dose 0.4 mg of aqueous extract than in the control group. The weaker effect of hydro-alcoholic extract was statistically significant.

Key words: *Rhodiola rosea, bacterial infection, mice.*

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Introduction

In people immunocompromised due to immunosuppressive treatment, cancer therapy, severe burns or other reasons, opportunistic infections are often seen [1-4]. *Pseudomonas aeruginosa* is one of the most frequently observed pathogens. *Rhodiola rosea* L. is a valuable medicinal herb known mainly as an adaptogen and anti-depressant. Its grows in Russia, Mongolia, China, Korea, Japan, Sakhalin, Kuriles, North America, Greenland and Europe [5]. In the previous studies performed *in vitro* in rats and pigs, we observed enhancement of intracellular respiratory burst and potential bactericidal activity in blood leukocyte cultures in the presence of *R. rosea* extracts [6]. In this study we observed the effect of feeding mice for 7 days *R. rosea* extracts on the subsequently induced bacterial infection in mice.

Material and Methods

Preparation of extracts

Rhodiola rosea (Crassulaceae) roots and rhizomes were cultivated, collected and identified in the Research Institute of Medicinal Plants (RIMP), Poznań, thanks to prof. Przemysław M. Mrozikiewicz and dr Waldemar Buchwald. Sample extractions and their chemical analysis were performed by the scientists from RIMP (Alina Mścisz, Anna Krajewska-Patan, Sebastian Mielcarek), and from Warsaw Medical University (Mirosława Furmanowa, Małgorzata Hartwich) as described before [6, 7]. Briefly: air-dried finely powdered roots were extracted two times with water (aqueous extract, RRW) or 50% ethanol (hydro-alcoholic extract, RRA), at 40-45°C, evaporated to dryness and lyophilized.

Animals

Studies were performed on B6C3F1 hybrid mice, males, at the age of 10-12 weeks, delivered from own breeding colony. All experiments were accepted by the local Ethical Committee.

Bacterial infection

Mice were fed *R. rosea* water extract (RRW) or hydro-alcoholic extract (RRA) 0.4 mg daily, in 10% ethyl alcohol, or 0.04 ml of 10% alcohol as a control, by Eppendorff pipette, for 7 days. On the day 8-ght mice were infected intraperitoneally (i.p.) with *Pseudomonas aeruginosa* strain ATCC (27 853). Four hours after administration of 0.1 ml of bacteria suspension (3×10^7 CFU) the mice were anaesthetized with barbiturates and killed by spinal dislocation after which the livers were isolated. The livers were homogenized and the number of viable bacteria were estimated by plating after 24 hours growth on Cetrymide agar (Merck) [8].

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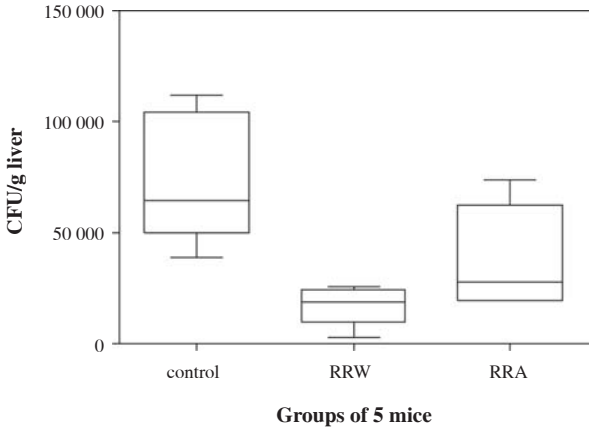

RRW: *Rhodiola rosea* water (aqueous) extract

RRA: *Rhodiola rosea* 50% hydro-alcoholic extract

Dunnett's Multiple Comparison Test	Mean diff.	q	Significant? p<0.05?	Summary
Control vs RRW	57140	4.044	Yes	**
Control vs RRA	36000	2.548	Yes	*

Fig. 1. Number of bacteria in livers of infected mice fed Rhodiola rosea (mean ± SD and range of results)

Statistical metods

The results were verified statistically by a one-way ANOVA analysis of variance and the significance of differences between the groups was verified with a Dunnett's Multiple Comparison test (GraphPadPrism software package).

Results

The results are presented graphically on the Fig. 1. A significantly decreased number of bacteria in livers of infected mice fed water extract of *R. rosea* was demonstrated in comparison to the control group. The weaker inhibitory effect of hydro-alcoholic extract was also statistically significant.

Discussion

Natural drugs, having immunostimulatory activity, may be a valuable complementation of the conventional anti-microbial treatment. In our previous studies, we observed stimulatory effect of *Rhodiola rosea* extracts on various parameters of non-specific and specific cellular immunity in mice, rats and pigs [6]. In this paper, we present evidence of the beneficial effect of *Rhodiola rosea* extracts (especially aqueous) on the bacterial infection in mice. This effect is probably connected with the ability of *Rhodiola* to stimulate various populations of immune cells, as was shown previously by us [6, 9, 10] and by others [11]. *Rhodiola rosea* is a plant traditionally consumed as a tea. A lot of articles have been published about its anti-stress and adaptogenic potential. Biologically active substances mainly found in plant rhizomes are salidroside, rosin, rosavin, rosarin, gallic and chlorogenic acids, and tyrosol [12, 13]. There are a few papers about direct anti-viral and anti-bacterial activity of *Rhodiola* extracts. Some compounds presented *in vitro* inhibitory activity against HCV NS3 serine protease – the most active were Epicatechin derivatives, present in *Rhodiola kirilowii* extracts. Salidroside was inactive in this test system [14]. However, other authors described *in vitro* and *in vivo* antiviral effects of salidroside isolated from *Rhodiola rosea* extract against coxsackievirus B3 [15]. *Rhodiola rosea* was also recognized as an inhibitor of HIV-1 protease [16]. Some compounds isolated from the roots of *Rhodiola kirilowii* (gallic acid and epigallocatechin gallate) exhibited *in vitro* inhibitory and bactericidal activities against mycobacterium tuberculosis [17]. It is noteworthy, that aqueous extract of *Rhodiola rosea* used in our present study contained three times more of gallic acid than hydro-alcoholic one [6]. Previously, we observed better stimulatory activity of aqueous extract of *Rhodiola rosea* than hydro-alcoholic one on cellular immunity (graft-versus-host reaction in mice) [6]. Accordingly, we also observed stronger inhibitory effect of aqueous than hydro-alcoholic extract on tumor-induced angiogenesis [7]. Whether or not these phenomena are connected with gallic acid, will be the matter of our further study.

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