Extract of *Rhodiola rosea* Radix Reduces the Level of C-Reactive Protein and Creatinine Kinase in the Blood

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The effects of extracts of *Rhodiola rosea* radix on blood levels of inflammatory C-reactive protein and creatinine kinase were studied in healthy untrained volunteers before and after exhausting exercise. *Rhodiola rosea* extract exhibited an antiinflammatory effect and protected muscle tissue during exercise.

Key Words: *C-reactive protein; creatinine kinase; Rhodiola rosea; muscle protection; adaptogen*

Professional athletes effectively use *Rhodiola rosea* ("golden radix") extract as a safe nonsteroid food additive improving endurance and rapid recovery of muscles during several decades [7]. *Rhodiola rosea* extract improves muscle work due to mobilization and more economic expenditure of energy resources of muscles [1]. The use of adaptogens including *R. rosea* improved physical endurance of male athletes, reducing blood lactate level and accelerating recovery after exhausting exercise [2,6,7].

Muscle injury involves inflammation (increase in blood IL-6 level) and increases the risk of myocardial infarction in subjects with latent cardiovascular diseases (particularly in those neglecting regular exercises) [9]. The inflammatory process plays an important role in the etiology of coronary disease. The relationship between increased blood concentrations of C-reactive protein (CRP) and creatinine kinase (CK) and muscle injuries in untrained subjects after exhausting physical exercise was demonstrated [12].

Here the effect of regular treatment with *R. rosea* extract and plasma levels of CRP and CK in untrained subjects before and after maximum exercise was evaluated in a double-blind placebo-controlled study.

MATERIALS AND METHODS

The study was carried out in 36 healthy untrained volunteers aged 21-24 years. All were non-smokers without symptoms of cardiovascular diseases for 12 months preceding the study and took no antiinflammatory drugs for 6 months before the study. Caffeine or ethanol-containing drinks were prohibited during the study. VO_{2max}, weight, fat percentage (by Moreno's method [13]), and initial blood levels of CRP and CK were measured before the study, after which the volunteers were randomly divided into 3 groups. The test for normal distribution and analysis of dispersions showed no appreciable differences between the groups.

Group 1 (n=12) received 340 mg RHODAX (preparation containing 30 mg active substances of *R. rosea* extract) twice a day (in the morning and evening) and group 2 (n=12) received 340 mg placebo for 30 days before and 6 days after exhausting physical exercise. Group 3 (n=12) served as the control. Exhausting physical exercise test was carried out on a computer-aided bicycle ergometer. The initial exercise of 20 W was gradually increased by 10 W/min. The test was discontinued after attaining physical exhaustion, when the volunteer could no longer rotate the pedals at a rate of 60 cycle/min.

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TABLE 1. Effect of Rhodax™ on Plasma CRP and CK Levels before and after Exhausting Physical Exercise ($M \pm m$, n=12)

Group	CRP, mg/liter			CK, U/ml		
	before test	5 h after test	5 days after test	before test	5 h after test	5 days after test
Control	0.3±0.2	1.1±0.2*	0.7±0.3*	166±35	1600±300*	2700±400**
Placebo	0.2±0.2	1.3±0.2*	0.8±0.3*	174±28	1670±270*	2820±390**
Rhodax™	0.3±0.2	0.7±0.2*+	0.4±0.2+	172±40	1630±330*	1450±330*

Note. p<0.05: *compared to the level before the test; **compared to the level 5 h after test; + compared to the control and placebo groups.

Blood for analysis was collected before the study (30 days before exercise test), 30 min before the test, 5 h and 5 days after the test. The blood was collected in the sitting posture at maximum 2-min tourniquet application [11]. The blood was immediately cooled on ice and centrifuged at 30,000*g* for 60 min. The plasma was stored at -70°C. CRP was measured by double enzyme immunoassay using immobilized and labeled rabbit antibodies to CRP. The sensitivity of this method was 0.1 mg/liter [11]. Standard serum with CRP was used for calibration [11]. Serum CK level was measured by spectrophotometry with standard Sigma reagents.

RHODAX (Phoenix Lab.) contains bioactive components rosavine, rosarine, rosine, salidroside, rhodalgin, acetylrhodalgin, rosiridine, and rosiridol. The composition was analyzed as described previously [10] and the typical RHODAX portrait obtained by high performance liquid chromatography.

The data were statistically processed using repeated-measures analysis of variance (ANOVA). Significant differences (p<0.05) were detected using Newman—Keuls post hoc test.

RESULTS

Exhausting physical muscle work appreciably increased CRP and CK levels in the blood of all volunteers (Table 1). This increase was less pronounced in group 1: 5 h after bicycle ergometer exercise CRP level in groups 2 and 3 increased 4-fold, while in group 1 only 2-fold. After 5 days the blood CRP levels in groups 2 and 3 remained increased (p<0.05), while in group 1 it did not differ from the initial level.

The mean CK level in the blood increased significantly after exhausting physical exercise (Table 1). Five hours after exercises this parameter was virtually the same in all groups. Five days after exercises CK activity in groups 2 and 3 further increased and 15-fold surpassed the initial level. In group 1 the blood CK content decreased and only 7-fold surpassed the initial level (Table 1). Hence, long-term treatment of untrained subjects with RHODAX inhibited the exhausting exercise-induced increase of the blood levels of substances serving as inflammationmarkers. RHODAX possesses antiinflammatory and, presumably, long-lasting adaptogenic effects.

Two promising trends in the use of *R. rosea* extract can be outlined: facilitation of recovery after exercise and decrease of the risk of cardiological disorders.

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