

Does *Rhodiola Rosea* Aid in Alleviating Exercise-Related Stress Response?

Tina M Penhollow* and Brittany Kimmons

Department of Exercise Science and Health Promotion, Florida Atlantic University, USA



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Abbreviations: MAO: Mono Amine Oxidase; FDA: Food and Drug Administration; ROS: Reactive Oxygen Species; THMPD: Traditional Herbal Medicinal Products Directive; RPE: Rate of Perceived Exertion

Introduction

Rhodiola Rosea is a flowering plant that grows naturally in the Arctic and colder regions, including North America, Asia, and Europe, known as arctic root, golden root, roseroot, or king's crown [1]. *Rhodiola Rosea* is an adaptogen. As the root word suggests, it supports the body's ability to adjust to change. Adaptogens can control cortisol secretion and improve the body's stress response; "they are natural bioregulators that increase the ability to adapt environmental factors and avoid the damage caused by those factors," [2]. The plant's root is known to increase energy, treat fatigue, stress, anxiety, and depression [3]. Salidroside is the most researched compound found in the root that has more than 140 active ingredients and responsible for its suggested adaptogen effects [4]. Salidroside is the active ingredient in *Rhodiola Rosea* and activates AMPK to enhance glucose uptake by skeletal muscle cells [5]. *Rhodiola Rosea*'s mechanism of action is to activate ATP synthesis in the mitochondria, increasing energy metabolism while regulating stress hormones release [3]. This regulation decreases the number of Reactive Oxygen Species (ROS) produced, limiting stress-induced damage to the mitochondria [3]. ROS are byproducts that are produced during skeletal muscle contractions. They are beneficial at moderate levels, influencing force production in the skeletal muscle. Increased ROS levels are also associated with muscle dysfunction, promoting fatigue. Proteins and lipids in myocytes are at risk of oxidative damage when ROS levels are increased, causing muscle atrophy and age-related muscle diseases [6]. High-intensity, prolonged exercise increases ROS production, negatively affecting muscle function [7]. In theory, *Rhodiola Rosea* should enhance work performance and increase time to reach fatigue by improving cellular energy metabolism. *Rhodiola Rosea* inhibits Monoamine Oxidase (MAO) activity, which breaks down epinephrine, norepinephrine, and serotonin, potentially serving as an anti-depressant [8]. This allows *Rhodiola Rosea* to influence moods by regulating neurotransmitter activity. Based on available studies, enhanced mitochondrial function is the most plausible source in improved exercised endurance [9].

Dosage

The recommended dosage for *Rhodiola Rosea* to combat stress is 400-600mg one time per day; 200-300mg one hour before exercise for enhanced performance effects based on referenced studies below. *Rhodiola Rosea* is not controlled by the Food and Drug Administration (FDA) and one should be cautious of unregistered, adulterated products. Purchasing a product registered by Traditional Herbal Medicinal Products Directive (THMPD) will lower risk of obtaining non authentic *Rhodiola Rosea* [10].

***Corresponding author:** Tina M Penhollow, Department of Exercise Science and Health Promotion, College of Science, Florida Atlantic University, Florida, USA

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Effects with Exercise

A group of 15 recreationally active college females were given a carbohydrate placebo or 3mg/kg dose of *Rhodiola Rosea* one hour before a six-mile stationary bike test. They then repeated the test with the opposite condition a week later. When *Rhodiola Rosea* was ingested before the test, participants experienced a decrease in heart rate and decreased time to complete the endurance test [11]. No significant differences were observed for perceived exhaustion. Another endurance bike test study looked at acute supplementation of 200mg of *Rhodiola Rosea* daily for four weeks with 24 physically active male and females. Participants increased time to exhaustion and increased oxygen uptake but did not increase performance [12]. Additionally, 26 healthy male students underwent 4 weeks of 600mg/day *Rhodiola Rosea* supplementation three times a day in 200mg doses or a placebo. This resulted in decreased reaction time but did not increase endurance exercise capacity [13]. There was no noticeable change in plasma cortisol levels between the two groups, but there was a minor decrease in lactate levels. This decrease was not significant enough to support *Rhodiola Rosea* anti-fatigue effects [13]. A review article by Panossian et al. [14] examined five clinical trials on *Rhodiola Rosea* ergogenic properties and concluded results were conflicting due to dosage. *Rhodiola Rosea* was active in moderate dosages and inactive in low or high dosages. Another study observed 10 physically active males perform a 30-minute submaximal bike test. Heart rate and Rate of Perceived Exertion (RPE) were recorded before, during, and after testing. The testing was completed two times within 72 hours, with either a placebo or 3mg/kg of *Rhodiola Rosea* ingested sixty minutes before testing. Participants showed no change in energy expenditure with the placebo or *Rhodiola Rosea*. Trials that included *Rhodiola Rosea* supplementation positively influenced RPE but did not alter energy metabolism, concluding that *Rhodiola Rosea* did not affect physiological markers [15].

Rhodiola Rosea did improve life-stress symptoms when taken 200mg twice a day for four weeks in a study of 101 subjects ranging from 30-60 years old [16]. Participants were not subjected to a physical test and completed five different types of questionnaires regarding psychological well-being throughout the four weeks. To enroll in the study, participants had to have a minimum of three of the seven perceived life-stress symptoms and had to score a 7 or greater on the Multidimensional Fatigue Inventory 20. A similar study was conducted with 118 participants of the same age group experiencing stress-related burnout. They consumed 400mg of *Rhodiola Rosea* daily for 12 weeks and showed immediate improvements in week one that continued throughout the trial [17]. This is important to mention because although exercise was not involved, studies show that *Rhodiola Rosea* influences mood and attitude. These participants most likely would show favorable results regarding a physical test measuring RPE. Stress in general can overwhelm the body preventing you from accomplishing tasks like exercising. Not being able to efficiently handle stress could directly affect your athletic performance and how your body responds to exercise [18].

Conclusion

High-intensity endurance exercise is exhausting to participate in generally. Studies suggest that supplementing *Rhodiola Rosea* can stimulate endorphins during endurance exercise allowing participants to prolong fatigue based on their tolerance level to pain. There is not enough research to prove that salidroside can enhance endorphin secretion or central nervous system endorphin sensitivity [12]. There are limited controlled studies performed on humans to prove *Rhodiola Rosea's* effect on the body's stress response to exercise. Early research conducted in Russia has not been translated or published but said to support *Rhodiola Rosea's* ability to have an ergogenic effect on healthy adults [9]. The available research supports acute effects on the participant's experience but does not improve performance or oxygen transportation to skeletal muscle tissue [19]. Researchers Duncan & Clarke [15] pointed out that participants may have been above or below their lactate threshold and different exercise intensities can influence perceived exertion. The majority of the presented research was conducted on young, healthy, active individuals. There would need to be a defined dosage and testing protocol established, and reproducibility to support the claim *Rhodiola Rosea* supplementation can positively affect the body's stress response to exercise. Currently, *Rhodiola Rosea* is a natural, low risk option to potentially assist your body to adapt to stress but collected studies show unclear evidence to confirm a therapeutic benefit.

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