



Figure 1. Velotron system

The Effects of an Acute Dose of *Rhodiola Rosea* on Exercise Performance and Cognitive Function

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Abstract

Background

The purpose of this study was to determine the effects of an acute oral dose of 3mg/kg of *Rhodiola Rosea* (R. Rosea) on endurance exercise performance, mood, and cognitive function.

Methods

A total of 15 recreationally active college women (21.3±0.09y, 56.1±6.3kg; mean±SD) participated in this study. 2-7 d after a familiarization trial subjects ingested in a double blind, random crossover manner, either R. Rosea or a carbohydrate placebo 1 h prior to testing. Exercise testing consisted of a 10 minute warm-up, standardized to 80% of the average watts produced during the familiarization trial, followed by a 6 mile simulated indoor time trial on a Velotron electronic bicycle ergometer. Every 5 min during the time trial, subjects rated their level of perceived exertion using a BORG 10 pt scale. A blood sample was taken pre warm-up, 2 minutes post warm-up, and 2 minutes following completion of the time trial, and was analyzed for lactate concentration. Subjects also completed a Profile of Mood States (POMS) questionnaire and a Stroop's color test pre-warm up and following the completion of the time trial. Subjects returned to the lab 2-7d later to repeat the testing with the other condition.

Results

A 3mg/kg acute dose of R. rosea resulted in a shorter time to completion of the 6 mile time trial course (R. Rosea 1544.7±155.2s, Placebo 1569.5±179.4s; mean±SD; p=0.06) as well as a lower average heart rate during the standardized warm up (R. Rosea 138.6±13.3bpm, Placebo 143.7±12.4bpm; mean±SD; p=0.001). There were no significant differences between treatment conditions for rating of perceived exertion during the time trial. Both treatments resulted in a significant increase in the POMS fatigue score following exercise (p=0.001), as well as a significant improvement following exercise for the Stroop's test of incongruent words (p=0.001). No other significant differences between treatments were observed.

Conclusion

Acute *Rhodiola Rosea* ingestion decreases the heart rate response to sub-maximal exercise, and appears to improve endurance exercise performance.

Purpose

To determine if an acute dose of R. rosea improves endurance exercise performance, cognitive function, and mood in recreationally fit college females.

Methods

- Prior to all testing, approval was obtained from the Institutional Review Board for human research at Gettysburg College
- 15 recreationally active college women (21.3±0.09y, 56.1±6.3kg; mean±SD) participated in this study.
- Subjects were required to refrain from caffeine and alcohol consumption, as well as strenuous exercise for 24h prior to all testing.

Familiarization Trial:

- Following a 10 minute warm-up at a self-selected pace, subjects completed a virtual 6 mile indoor time trial on a electronic bicycle ergometer (Velotron, Racermate Inc.) that was interfaced to a computer that converted the subject's work into a virtual display of a cyclist riding a course (Figure 1).

Testing:

- 2-7 days after the familiarization trial, subjects ingested in a random double blind cross over manner, either 3mg/kg R. rosea or a carbohydrate placebo, 1 hr prior to testing.
- Subjects warmed up for 10 minutes at a workload that was 80% of their average watts produced in the familiarization time trial.
- Following the warm-up, subjects completed the 6 mile indoor time trial that was used for the familiarization trial.
- At 5 minute intervals during the test, subjects indicated rating of perceived exertion (RPE) using the BORG 10 pt scale.
- A blood sample was taken via vena puncture of the finger pre and post warm-up, and 2 minutes post time trial. Samples were analyzed for lactate concentration using a YSI lactate analyzer.
- A Profile of Mood States questionnaire (POMS) and a Stroop's color test were completed prior to the warm-up and post time trial.
- Subjects returned to the laboratory 2-7d later to repeat the testing with the opposite condition.

Results

Table 1. Profile of mood states (POMS) and Stroop's test, pre and post-trial (N=15). Fatigue increased for both treatments pre to post trial (p=0.001). All other dimensions of the POMS were not significant. There was a significant time effect found for incongruent words in the Stroop's test (p=0.001), with no differences found between treatments.

Mood/ Condition	Treatment	Pre-Trial Mean	Post-Trial Mean	Within-Subject Effects Time	Within-Subject Effects Time* Treatment
Fatigue	R. rosea	7.1 ± 3.0	9.7 ± 4.2	p=0.001	p=0.357
	Placebo	7.3 ± 4.4	11.5 ± 4.6		
Tension	R. rosea	10.5 ± 4.7	9.5 ± 5.0	p=0.122	p=0.615
	Placebo	11.1 ± 5.2	9.1 ± 5.0		
Confusion	R. rosea	6.7 ± 3.4	5.2 ± 2.5	p=0.084	p=0.410
	Placebo	6.9 ± 4.1	6.3 ± 3.9		
Anger	R. rosea	5.3 ± 4.6	4.3 ± 2.6	p=0.319	p=0.667
	Placebo	5.9 ± 6.2	5.5 ± 6.8		
Vigor	R. rosea	15.7 ± 6.3	15.0 ± 4.9	p=0.408	p=0.868
	Placebo	13.9 ± 4.8	12.9 ± 5.8		
Depression	R. rosea	4.7 ± 5.7	4.4 ± 4.8	p=0.317	p=0.678
	Placebo	6.5 ± 6.2	5.7 ± 5.8		
Stroop's test	R. rosea	37.8 ± 4.3s	37.1 ± 6.0s	p=0.802	p=0.504
	Placebo	38.2 ± 4.2s	38.5 ± 4.9s		
Stroop's test	R. rosea	73.7 ± 7.6s	67.5 ± 6.6s	p=0.001	p=0.156
	Placebo	76.2 ± 11.5s	68.9 ± 10.1s		

Results Cont'd

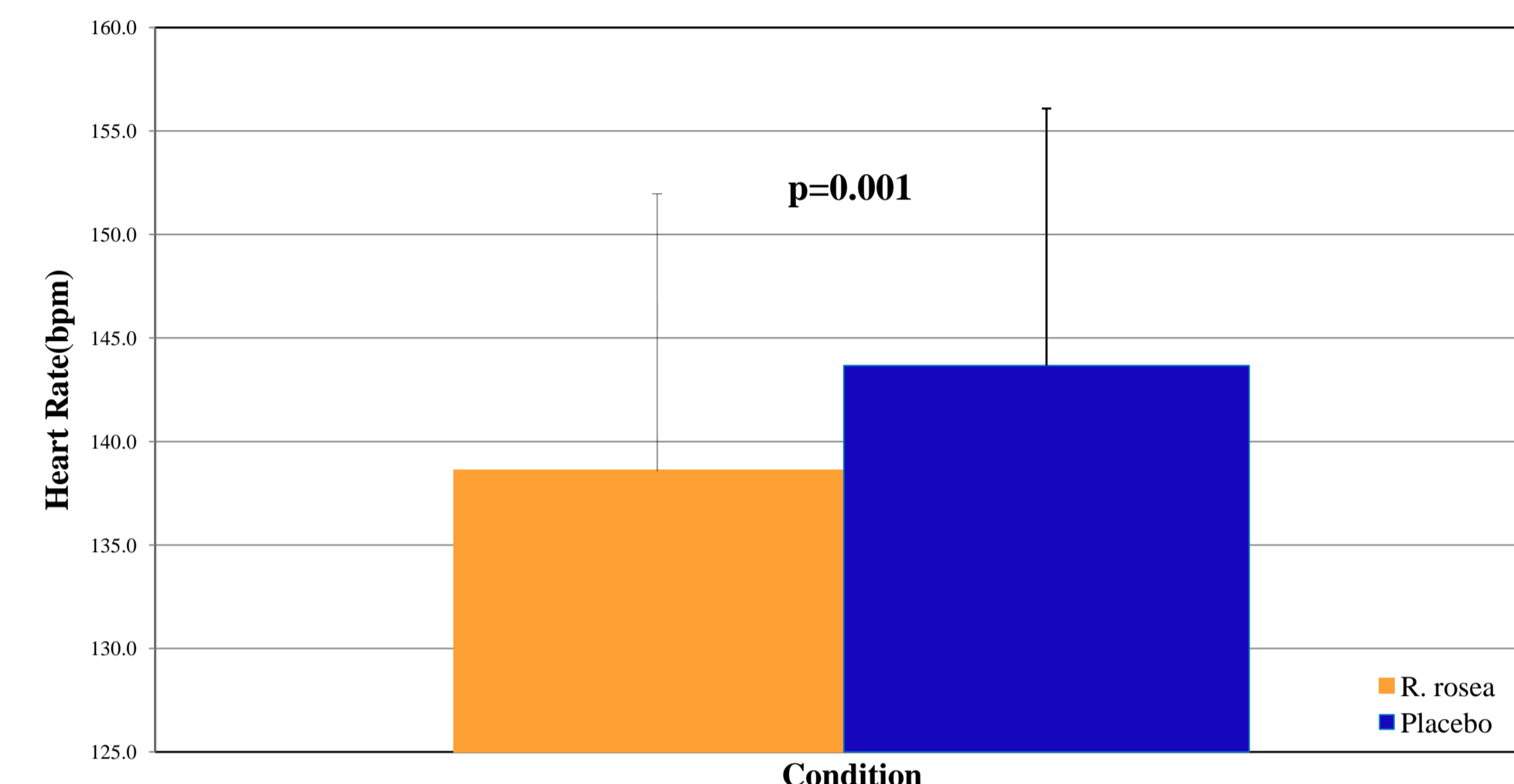


Figure 2. Average HR and standard deviations during the standardized warm-up with R. rosea and the placebo. There was a significant difference found between the two conditions (p=0.001).

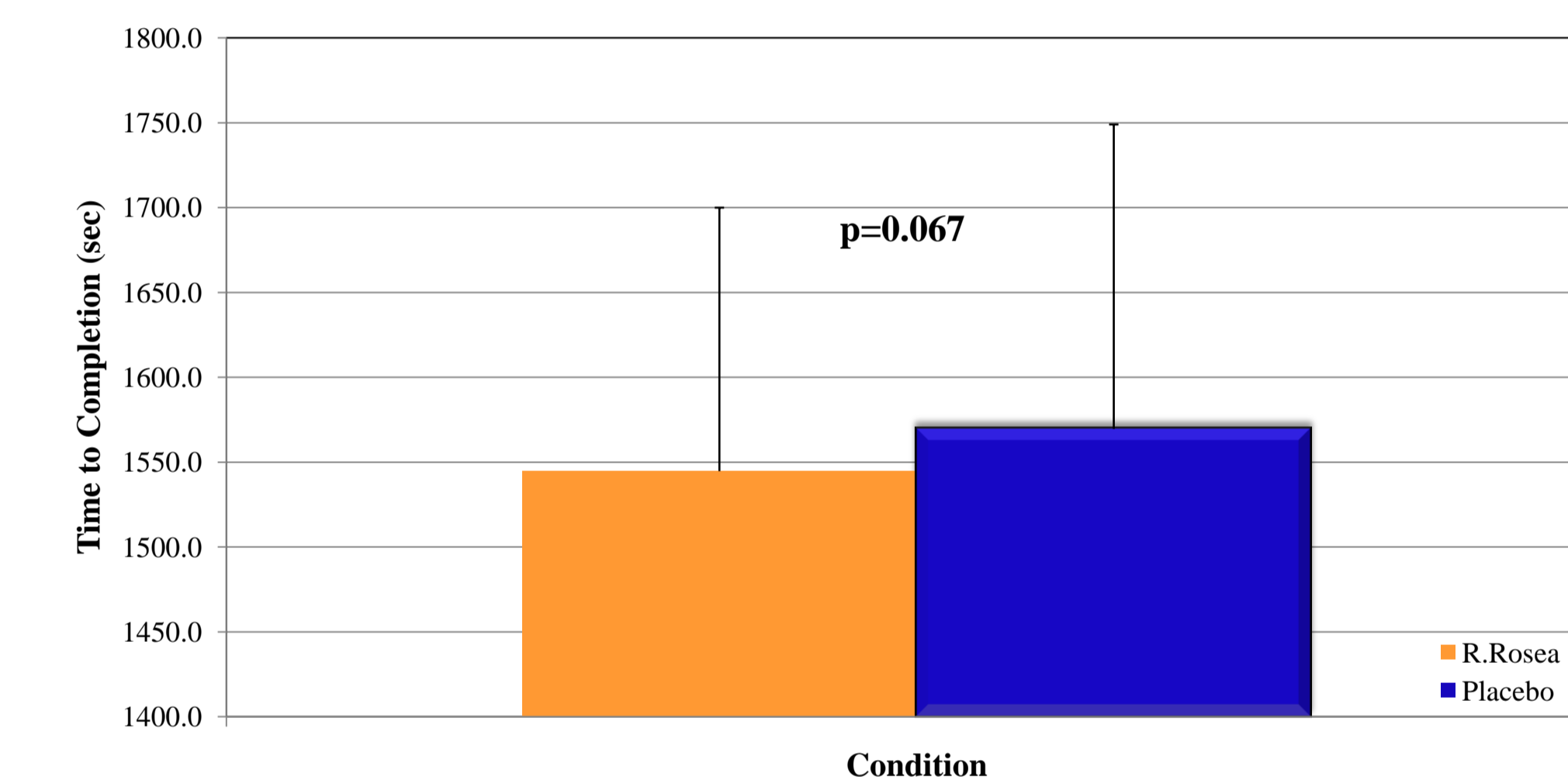


Figure 3. Time to completion of the 6 mi trial course. The R. rosea group completed the trial faster than the placebo group. The mean difference between groups was 24.8 seconds and approached statistical significance (p = 0.67) using a two tailed repeated measures t test.

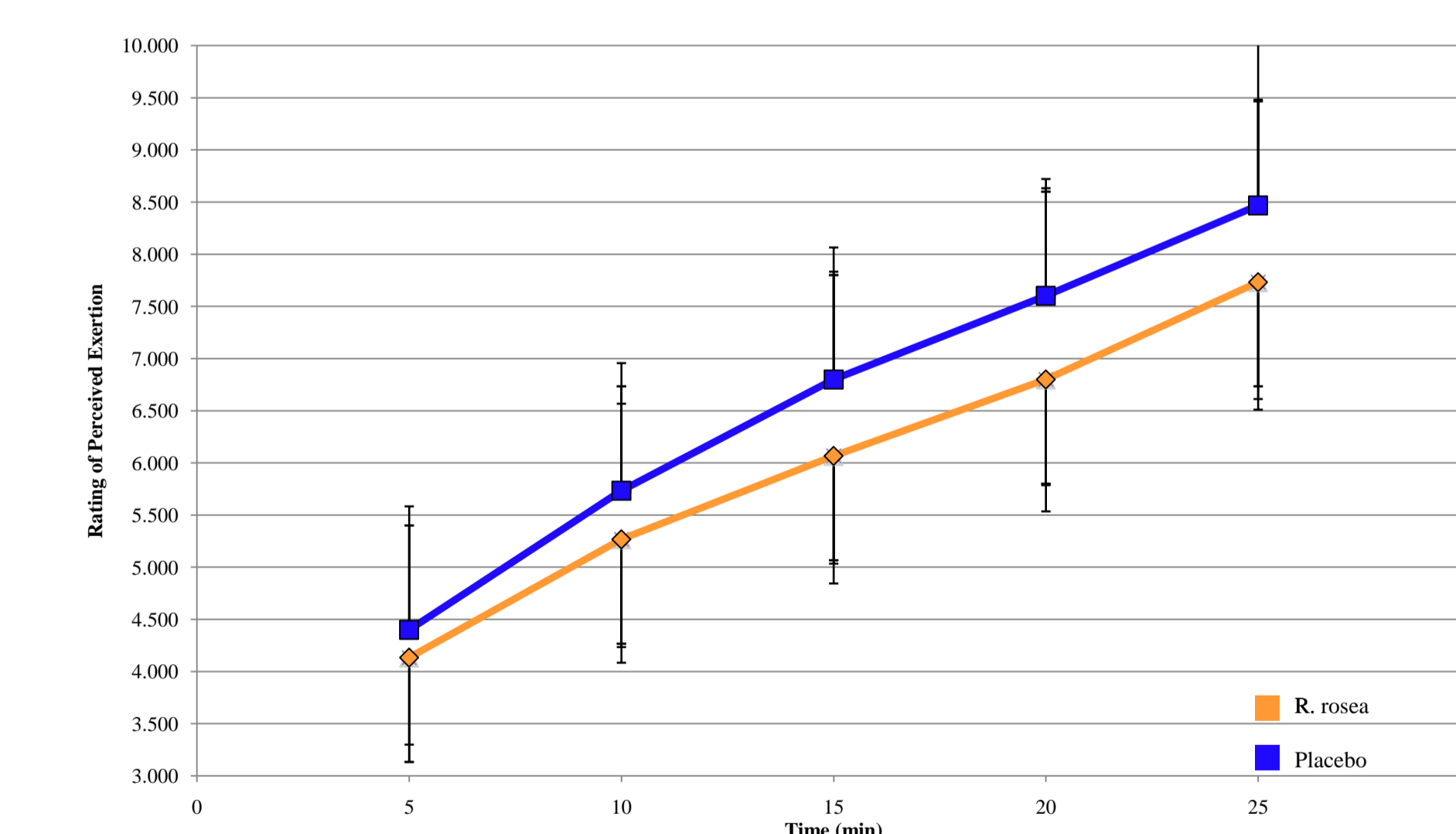


Figure 4. Rating of Perceived Exertion (RPE) during trial. There was a significant effect in RPE over time (p<0.001) with no differences found between treatments.

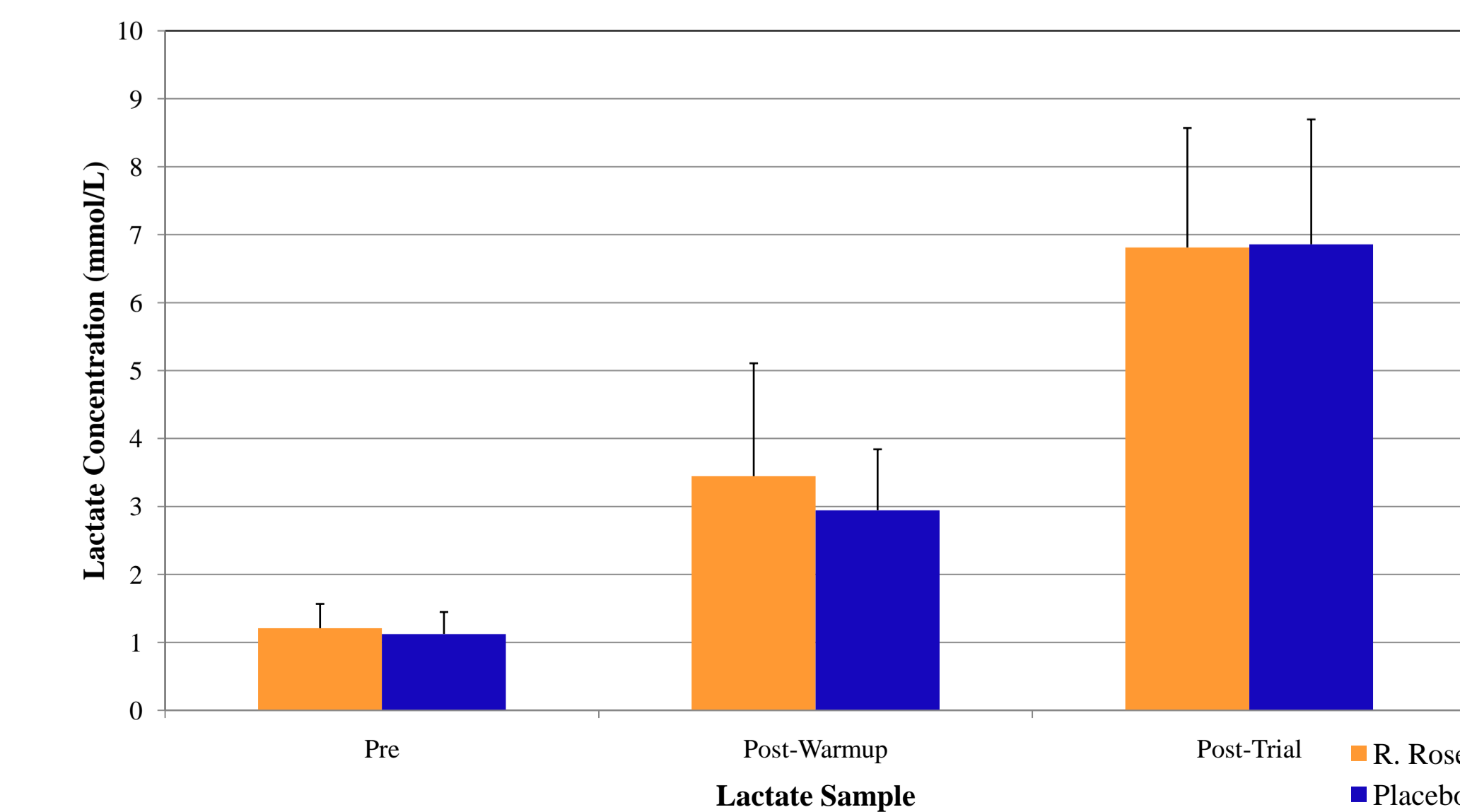


Figure 5. Blood lactate concentration. There was a significant time effect (p<0.001) with no differences found between treatments.

Discussion

- The main finding of this study was that acute ingestion of R. rosea decreased heart rate response to submaximal exercise (p=.001).
- With the current data, it is unclear what mechanism(s) is responsible, however a decrease in sympathetic tone is associated with a decrease in heart rate. Future analysis of salivary samples collected during the present study should allow for the determination of sympathetic hormone levels.
- At a constant workload, cardiac output between the treatments should remain constant, suggesting an increase in stroke volume following R. rosea ingestion.
- Other manipulations that result in an increased stroke volume have been shown to increase endurance exercise performance (14).

- In this study it appears that acute ingestion of R. rosea improves endurance exercise performance (p=0.067).
- The small sample size and large standard deviations observed for time trial completion times strongly suggest a type II error.
- If this is a true effect, this is in agreement with the only other study published on the effects of acute R. rosea ingestion on endurance exercise performance in humans. However, neither the present data, nor the previous study clearly identifies a mechanism responsible for this improvement (15).
- It is tempting to speculate that the reduced heart rate seen (and the assumed increase in stroke volume) during the warm-up in the present study is associated with the improved endurance exercise performance.

- Previous studies have suggested that R. rosea may improve cognitive function (11), which could improve endurance exercise performance.
- However, the present study found no significant effect between treatments for the Stroop's test, POMS, or RPE.
- The similar values observed between treatments for RPE may be misleading since it appears that subjects were exercising harder following acute R. rosea ingestion.
- This may be indicative of a decreased perception of fatigue following acute R. rosea ingestion.

Conclusions

Acute ingestion of 3mg/kg of R. rosea resulted in a decrease in heart rate during submaximal exercise (p=0.001). R. rosea also appears to improve endurance exercise performance (p=0.067). The comparable RPE seen between treatments suggests that R. rosea may allow a subject to exercise harder without perceiving this extra effort.

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Introduction

• *Rhodiola rosea* (R. rosea), is an adaptogenic plant found in the mountainous regions of North America, Europe and Asia. The root of this herb has been used in traditional medicine for centuries to treat a variety of ailments including: fatigue, depression, anemia, impotence, infection, tuberculosis, diabetes, and cancer (1).

• R. Rosea has been shown to possess both anti-oxidant and anti-inflammatory properties, helping to improve cognitive function and reduce mental fatigue, to reduce biological markers of physiological and psychological stress, and to improve endurance exercise performance(2,3,4,5).

• Possible mechanisms by which R. rosea can improve endurance exercise performance include: increased cellular ATP levels, increased glucose uptake in skeletal muscle, increased muscle tissue oxygen saturations, and increased levels of β-endorphins, which act as a natural pain reliever. (6,7,8)

• Previous studies have shown that the chronic administration of R. rosea improves mental states, such as depression, anxiety, and central nervous system fatigue(9,10,11).

• Acute administrations of R. rosea have been shown to be beneficial in situations requiring a rapid response to outside stress, such as mental tasks and exercise bouts, leading to enhanced performance (12).

• Some studies that have administered an acute dose of R. rosea have shown an increase in neurotransmitter diffusion, which may positively affect mental and physical performance through improved cognitive function (13).

• The majority of the data on R. rosea comes from either older Russian studies with questionable experimental control, or more recent *in vitro* studies.

• More research is necessary to understand the effects of R. rosea *in vivo*.