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BRIEF NOTE

Rhodiola rosea does not reduce in vivo inflammatory activity after continuous endurance exercise

Rhodiola rosea ne réduit pas l'activité inflammatoire in vivo après un exercice d'endurance continu



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Summary

Introduction. – It is believed that *Rhodiola rosea* is able to reduce various stressors caused by chemical and biological factors. Studies have demonstrated that *Rhodiola rosea* is able to retard muscle damage caused by intense exercise; however, whether this effect is related to inflammatory cytokines remains unknown. The purpose of this study is to examine the impact of *Rhodiola rosea* administration after continuous endurance exercise on the inflammatory responses.

Summary of facts and results. – Twelve healthy subjects were recruited. The study was a randomized, double-blind, crossover study, composed of two 8-day trials, each separated by a 2-week washout phase. Each trial included a 3-day exercise period consisting of a 30-min run at 75% VO_2max per day followed by a 5-day recovery period. The subjects were given two orally administered capsules of placebo (P) or *Rhodiola rosea* (Rh) per day during the recovery period and immediately after continuous exercise. At 24 and 48 h after the exercise, the blood creatine kinase (CK) levels were higher than those before exercise in both groups. The blood variables had returned to the baseline level at 24 h after exercise except the CK level. The CK levels were lower in the Rh group than that in the P group 72 h after continuous exercise (208.2 ± 32.7 vs 136.7 ± 13.8 U/L, $P < .05$). However, there was no significant difference in other blood variables between groups.

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MOTS CLÉS

Créatine kinase ;
Protéine C-réactive ;
Interleukine 6

Conclusion. – The main finding of this study is that supplementation of *Rhodiola rosea* after continuous endurance exercise has a trend to decrease blood CK levels moderately, but it is unable to reduce inflammatory reactions.

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Résumé

Introduction. – On pense que la *Rhodiola rosea* est capable de réduire divers facteurs de stress causés par des facteurs chimiques et biologiques. Des études ont démontré que la *Rhodiola rosea* est capable de retarder les dommages musculaires causés par un exercice intense. Cependant, si cet effet est lié aux cytokines inflammatoires, cela reste encore inconnu. Le but de cette étude est d'examiner l'impact de l'administration de la *Rhodiola rosea* après un exercice d'endurance continu sur les conséquences inflammatoires.

Synthèse des faits et résultats. – Douze sujets sains ont été recrutés. L'étude était une étude croisée, randomisée et croisée à l'aveugle, composée de deux essais de 8 jours, chacun étant séparé par une phase d'élimination de 2 semaines. Chaque essai comprenait une période d'exercice de 3 jours consistant en une course de 30 minutes à 75% VO₂ max par jour suivie d'une période de récupération de 5 jours. Les sujets ont reçu deux capsules orales de placebo (P) ou *Rhodiola rosea* (Rh) par jour pendant une période de récupération et immédiatement après l'exercice en continu. À 24 et 48 heures après l'exercice, les taux sanguins de créatine kinase (CK) étaient plus élevés que ceux observés avant l'exercice dans les deux groupes. Les variables sanguines étaient revenues au niveau de référence à 24 h après l'exercice sauf le niveau de CK. Les niveaux de CK étaient plus bas dans le groupe Rh que dans le groupe P 72 h après l'exercice continu (208,2 ± 32,7 vs 136,7 ± 13,8 U/L, *p* < 0,05). Cependant, il n'y avait aucune différence significative dans les autres variables sanguines entre les groupes.

Conclusion. – La principale conclusion de cette étude est que la supplémentation de *Rhodiola rosea* après un exercice d'endurance continu a tendance à diminuer modérément les taux de CK dans le sang, mais elle est incapable de réduire les réactions inflammatoires.

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1. Introduction

Moderate exercise can enhance the immune system, while intensive exercise may inhibit immune system function. Several studies have shown that a single period of prolonged medium- to high-intensity exercise significantly increases the concentrations of cytokines, such as interleukin-1 (IL-1), IL-6, and tumor necrosis factor-alpha (TNF- α), leading to the production of acute-phase proteins and overall inflammation, which may lead to altered immune responses in vivo [1]. *Rhodiola rosea* is believed to be an adaptogenic plant that reduces the serum CRP concentration, creatine kinase (CK) activity, and muscle damage caused by intense exercise [2]. Although previous studies have suggested that *Rhodiola rosea* may decrease the CRP level, the effect of *Rhodiola rosea* on the inflammatory cytokine levels remains unclear. Existing research in inflammatory cytokine response has ignored the role of *Rhodiola rosea* in interpreters. Hence, in order to help fill this gap in our knowledge, this study investigates the effects of *Rhodiola rosea* supplementation on inflammatory response after continuous endurance exercise.

2. Methods

2.1. Participants

Twelve male volunteers (Age: 24.7 ± 0.5 years, height: 175.0 ± 1.1 cm, and weight: 72.1 ± 2.4 kg) completed this randomized, double blind, crossover experimental research study. This investigation received the approval from the National Taiwan Sport University (Taoyuan, Taiwan), and the trial was conducted in accordance with the Declaration of Helsinki and approved guidelines. All subjects were healthy, physically active, college students with normal dietary habits.

2.2. Design and procedures

Maximum oxygen consumption (VO₂max) was determined in the pre-experimental period. Each subject presented to the laboratory 7 days before the start of the actual study and performed an incremental running test on a motor-driven treadmill according to the Bruce protocol until exhaustion.

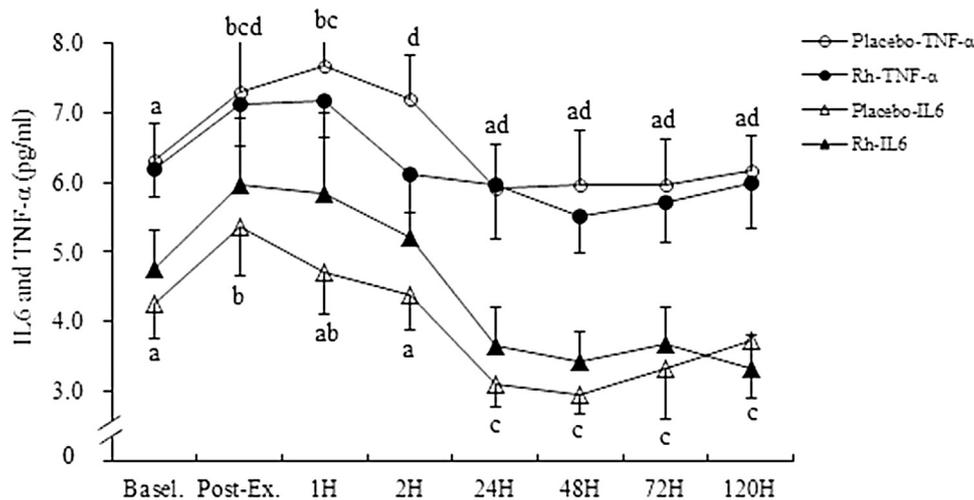


Figure 1 Comparison of IL-6 and TNF- α concentrations by group at each observation time point. Placebo: placebo group; Rh: *Rhodiola rosea* group; Conc.: concentration; Basel: baseline; Post-Ex: immediately after exercise; H: hour; Different letters indicate significant differences ($P < 0.05$). The observation time points sharing a common letter are not significantly different from each other.

To determine the baseline endurance performance time, $VO_2\max$ was measured by an automated system. The study was a randomized, double-blind, crossover study, composed of two trials, each separated by a 2-week washout phase. Each trial lasted 8 days and consisted of a 3-day exercise period (30 min run at 75% $VO_2\max$ per day) and 5-day recovery period. Blood samples were taken before the exercise on day 1 (baseline), immediately after exercise on day 3, and 1, 2, 24, 48, 72, and 120 h after exercise. The plasma CK and lactic acid (LA) were measured by spectrophotometry by means of ultraviolet test kits. IL-1 beta (IL-1 β), IL-6, TNF- α , and CRP levels were investigated by enzyme-linked immunosorbent assay.

2.3. *Rhodiola rosea* supplementation

Each subject was instructed to ingest either two Rh capsules (400 mg Rh per capsule) daily after exercise or hydroxymethylcellulose placebo in the same capsule form (both provided by Standard Chem & Pharm Co., Taiwan). The allotment was received immediately after the third exercise and during the recovery period. Subjects received the capsules at 8 o'clock every morning before breakfast during the recovery period.

2.4. Statistical analysis

SPSS 19.0 was used to perform all analyses. Differences in blood variables between the two treatment levels were analyzed by factorial (time \times treatment) ANOVA with repeated measures. Fisher's LSD post hoc test was used to determine any significant difference. Significance was accepted at the P -value < 0.05 level. All data are presented as mean \pm SE.

3. Results

All the levels of blood variables, besides the IL-1 β , were significantly higher after exercise than before exercise in

both groups ($P < 0.05$). However, there are no significant differences between groups. The LA levels immediately after exercise was higher than those at subsequent time points. The LA levels 24 and 48 h after exercise were significantly lower than those at baseline ($P < 0.05$). Immediately and 1 h after exercise, the IL-6 levels were significantly higher than those of others. However, the IL-6 level 2 h after exercise returned to the baseline level, and the IL-6 levels 24, 48, 72, and 120 h after exercise were significantly lower than the baseline level (Fig. 1). The TNF- α level in both groups reached the highest point 1 h after exercise and returned to baseline level (Fig. 1). There was no difference in CRP concentrations within and between groups. The CK concentrations in the two groups increased significantly immediately after exercise and were still found to be significantly higher at 24 and 48 h after exercise than the baseline level (P , 222.9 ± 22.8 and 231.7 ± 33.8 vs 154.2 ± 17.5 ; Rh, 205.1 ± 24.4 and 163.7 ± 21.4 vs 141.2 ± 10.5 U/L; $P < 0.05$, Fig. 2). Moreover, the CK concentration was different significantly between the placebo and Rh group 72 h after exercise (208.2 ± 32.7 vs 136.7 ± 13.8 U/L, $P < 0.05$, Fig. 2).

4. Discussion

This study found that a 5-day supplement of *Rhodiola rosea* after 3 days of moderate-intensity exercise cannot regulate the production of inflammatory cytokines (Fig. 2). Although the blood CK level was lower in the Rh group than that in the P group 72 h after continuous exercise, muscle damage was gradually improved during the recovery period with *Rhodiola rosea* administration.

In our study, blood cytokine levels 24 h after exercise had recovered to their baseline levels, and CK and CRP concentrations remained higher than those at baseline. These findings were similar to the study of Abidov et al. [3]. A previous study has demonstrated that in vivo IL-6 and TNF- α concentration is strongly influenced by exercise intensity and duration. An ample of studies have indicated that the level of TNF- α rarely changes and increased smaller

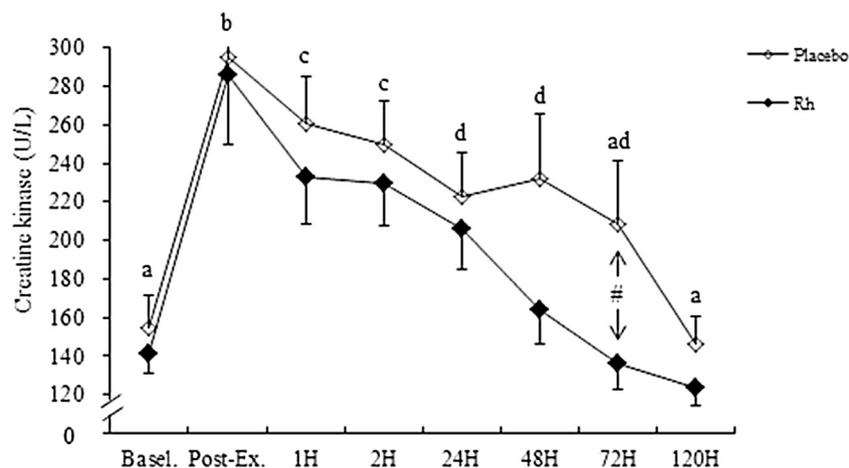


Figure 2 Comparison of CK concentrations by group at each observation time point. Placebo: placebo group; Rh: *Rhodiola rosea* group; Conc: concentration; Basel: baseline; Post-Ex: immediately after exercise; H: hour; Different letters indicate significant differences ($P < 0.05$). The observation time points sharing a common letter are not significantly different from each other. #: significant difference between placebo and Rh Group at the time point. Different letters indicate significant differences ($P < 0.05$).

by high-intensity and long-duration exercise. However, the highest IL-6 concentration usually occurs immediately after exercise and rapidly reduces thereafter. Therefore, we believe that the increase in the IL-6 and TNF- α level immediately after exercise is due to the effect of an acute bout of moderate-intensity aerobic exercise on day 3, rather than the accumulating effect of the 3-day consecutive exercise. It may explain the limited increment in the IL-6 and TNF- α level in the present study. Besides, we do not exclude that the supplementation of *Rhodiola rosea* cannot affect to the cytokines, due to the small sample size. The results seem have some mistakes in a statistical type 2 error (beta-risk), and it will be verified in further research.

Empirical evidence has indicated that exercise intensity and duration of an acute exercise play a major role in enhancing the blood CK and CRP concentrations and correlate with muscle damage [4]. In our study, we did not assess local muscle damage after exercise. Thus, based on the present blood biochemical data, it is reasonable to deduce that our exercise model may trigger muscle damage. In the Rh group of the present study, the blood CK concentration was lower than that in the P group 72 h after continuous exercise. This finding is in accord with the results of the previous studies and supports the view that short-term supplementation of *Rhodiola rosea* can attenuate the CK level induced by submaximal exercise.

5. Conclusions

This study demonstrated that short-term *Rhodiola rosea* supplementation after continuous submaximal aerobic exercise

does not reduce the serum levels of inflammatory indicators including IL-1 β , IL-6, TNF- α , and CRP during the recovery period. Therefore, *Rhodiola rosea* supplementation has a trend to decrease blood CK levels moderately, which may indicate that *Rhodiola rosea* tends to gently improve recovery from exercise-induced muscle damage. In future studies, the effect of pre-exercise administration of *Rhodiola rosea* on inflammation and muscle damage induced by exercise, therefore, may also be investigated.

Disclosure of interest

The authors declare that they have no competing interests.

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