Original Research Article

Evaluation of the therapeuticof the standardized dry extract of *Rhodiola Rosea* in physical activity practiotioners

ABSTRACT

Aims: To evaluate the effects of *Rhodiola rosea* supplementation on physical performance, glycemic levels, and cardiovascular parameters in a clinical trial.
Study Design: Randomized crossover clinical trial.
Place and Duration of Study: The study was conducted with participants aged between 20 and 40 years from [local details], between [start date] and [end date].
Methodology: Twenty-five participants (12 females and 13 males) were randomly divided into two groups. Each group received starch treatment and dry extract of *R. rosea* at different times, with an interval period between the treatments. Weight, systolic and diastolic blood pressure, heart rate, glycemic levels, and perceived effort (assessed by the Borg scale) were measured at baseline and the end of each treatment phase. Lactate levels were also evaluated. Statistical analyses compared intra- and intergroup variations, considering $p<0.05$ as significant.
Results: Analyses revealed no significant changes in weight, systolic and diastolic blood pressure, heart rate, or glycemic levels within or between groups. Perceived effort did not differ significantly between treatments. However, a significant variation in lactate levels was observed.
Conclusion: Supplementation with *R. rosea* may offer potential benefits for endurance and stamina in sports activities, although further studies are needed to confirm its efficacy.

Keywords: Keywords: Rhodiola rosea, clinical trial, physical exercise, lactate, endurance.

1. INTRODUCTION

Rhodiola rosea, commonly known as "golden root," is a herbaceous plant belonging to the Crassulaceae family [1]. Its distribution spans cold regions of Europe, Asia, and North America [2]. Over time, it has been employed to enhance physical endurance, mental performance, longevity, and the treatment of various conditions such as fatigue, depression, anemia, impotence, gastrointestinal problems, infections, and disorders of the neural system [3,4,5].

Studies have revealed adaptogenic properties of *R. rosea* 6, which regulate and enhance the response to stress, encompassing neuroprotective, anti-fatigue, and stimulating activities for the central nervous system. These effects appear to be linked to the modulation of the Hsp70 protein, which, in turn, inhibits the expression of the nitric oxide synthase (NO) gene and interacts with glucocorticoid receptors, resulting in the reduction of circulating levels of NO and cortisol [7].

The phytochemical analysis of *R. rosea* reveals the presence of phenolic, propanoic, and flavonoid compounds [8]. Among the most significant active components are salidroside, tyrosol, rosarin, rosin, rosavin, and essential oils such as decanol and geraniol [9]. To effectively confirm the promising activities of this plant, it is essential to conduct clinical studies involving different population groups and scenarios.

Therefore, the objective of the present study was to assess the efficacy of the oral administration of *R. rosea* dry extract in individuals engaging in physical activities.

2. MATERIAL AND METHODS

The present study is characterized as a double-blind, randomized clinical trial. The set of selected participants (n=25) was randomly distributed into two distinct groups: the PLA group (which received a placebo) and the RhR group (exposed to the extract of *Rhodiola rosea*). In this double-blind design, both the responsible researchers and the participants themselves remained unaware of the treatment allocation.

The standardized dry extract of *Rhodiola rosea* was compared to a placebo composed of starch in a sample of volunteers who are runners in the city of Palmas-Tocantins. The preparation of these formulations was carried out in a duly licensed and certified pharmaceutical compounding facility by local regulatory authorities in Palmas-Tocantins. The experimental protocol adopted in this study was adapted from previous research, particularly from the study conducted by Noreen et al [2]. Additionally, the study followed the guidelines outlined in the Technical Manual of the Ministry of Health [10], titled: "Operational instructions: Information necessary for the conduct of clinical trials with herbal medicines."

The research involved 25 volunteers of both genders engaged in running activities three times a week. They were randomly divided into two groups, as illustrated in Table 1. In the first week (Treatment 1), Group 1 was assessed for placebo use (Sample A) for 7 days, followed by a 7-day organism cleansing interval. Subsequently, in Treatment 2, Group 1 received *R. rosea* (Sample B) for 7 days. Group 2 followed the reverse order, using Placebo Sample B in the first treatment and Sample A in the second treatment.

Table 1. Experimental Protocol.

Group	Treatment 1 (7 days)	Treatment - Free Days	Treatment 2 (7 days)
1	Sample A (n=13 H)	7 days	Sample B (n=13 H)
2	Sample B (n=12 M)	7 days	Sample A (n=12 M)

(Sample A: placebo (starch), Sample B: R. rosea).

All participants underwent measurements of blood pressure and heart rate before and after the running activity using a portable electronic device (Omron HEM-7113). Subsequent assessments related to capillary levels of glucose and lactate were conducted using portable electronic devices, specifically the Accu-Chek Active® and Accutrend® Plus, respectively. Additionally, participants' perceived levels of exertion were evaluated after exercise using the Borg Scale, which operates on a numerical scale ranging from 6 to 20 points [11,12] (Borg, 1998, 2000), following prior verbal instructions.

The data obtained were properly cataloged in spreadsheets and subjected to analyses using Graph Pad Prism 6.0 software. This encompassed descriptive analyses, ANOVA, and the Tukey test for mean comparisons between groups.

The research project and the Informed Consent Form were submitted and approved under reference number 2.891.986 by the Research Ethics Committee with Human Subjects at the Federal University of Tocantins.

3. RESULTS AND DISCUSSION

The sample, comprised of 25 volunteers, including 12 women and 13 men, with the latter group representing 52% (n=13) of the total evaluated, had an age range between 23 and 44 years. Remarkably, many volunteers, accounting for 56% (n=14) of the sample, were in the age range of 34 to 44 years, as demonstrated in Table 2.

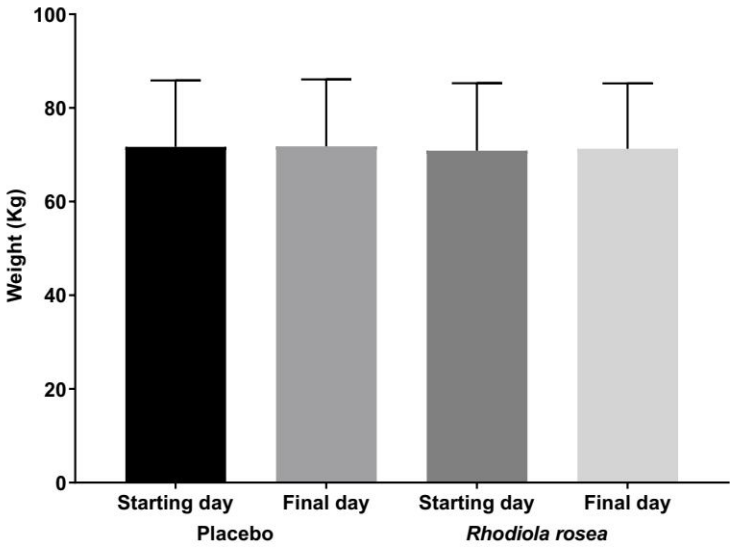
Table 2. Characteristics of research participants.

Age (years)	A.F	R.F (%)
22-33	11	44
34-44	14	56
Total	25	100
Gender	**A.F**	**R.F (%)**
Feminine	12	48
Masculine	13	52
Total	25	100

(A.F.: Absolute Frequency; R.F.: Relative Frequency)

Throughout the period of exposure of the volunteers to the herbal remedy, it was not possible to observe variations in the weight of the participants, covering the interval that includes the first and last day of treatment (Figure 1). Similarly, the results obtained during the placebo administration period followed the same trend, as evidenced in Figure 1.

Figure 1. Evaluation of weight between the placebo and test (*Rhodiola rosea*) groups between the initial and final days of treatment application (n=25).



Considering the test period, it is essential to emphasize that it could not be conclusively inferred that the use of the herbal remedy resulted in weight reduction for therapeutic purposes. Therefore, it becomes imperative to highlight that, even though this phyto-medicinal agent is occasionally marketed for weight loss, there is, as of the present moment, no support in the scientific literature to corroborate such a purpose.

It is worth noting that all participants were instructed to keep their dietary habits unchanged, as well as their routine and intensity of physical exercises, thus ensuring the absence of any biases in the results obtained in the scope of this research.

Regarding the assessment of blood pressure measures (Figure 2) among the analyzed groups, there was an absence of substantial variations between the initial and final stages of each treatment phase. This observation also applied to the

heart rate of the volunteers, both over the period that encompassed the beginning and end of each treatment, and in the comparison between the placebo group and the group subjected to the test with *R. rosea* (Figure 3).

Figure 2. Evaluation of blood pressure between the placebo and test (*Rhodiola rosea*) groups between the initial and final days of treatment application (n=25). (A) Systolic blood pressure (B) Diastolic blood pressure.

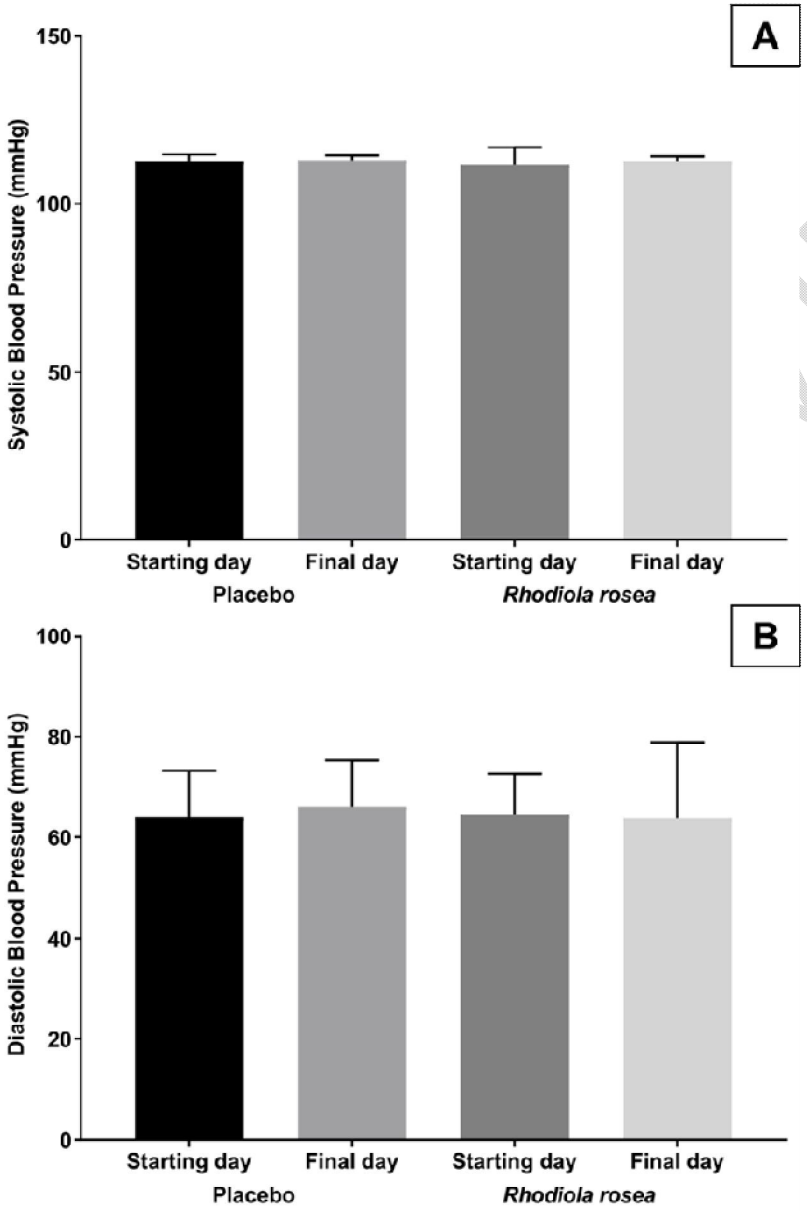
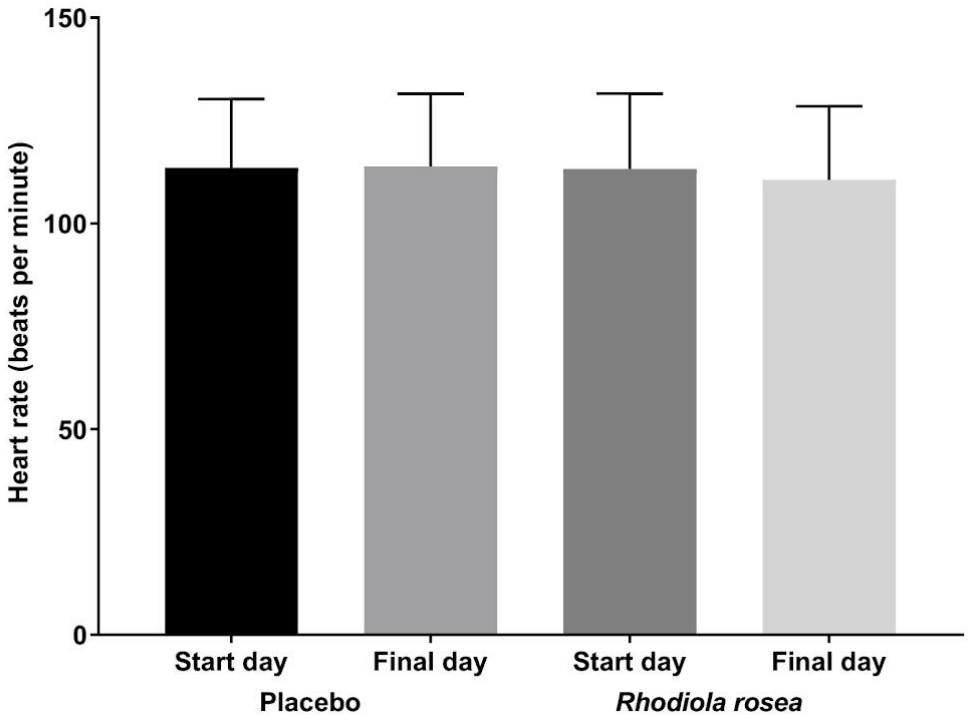


Figure 3. Evaluation of heart rate between the placebo and test (*Rhodiola rosea*) groups between the initial and final days of treatment application (n=25).



With the purpose of assessing the effects of chronic supplementation based on *R. rosea* over a four-week period on the athletic performance of athletes engaged in endurance exercises, Parisi et al 13 conducted a clinical trial. In this study, it was found that the analyzed parameters showed no variations when compared to those resulting from the placebo treatment. Specifically, heart rate remained essentially unchanged in both groups. In contrast, Noreen et al 14 found different results, as the intake of *R. rosea* led to a significant reduction in heart rate during a moderate warm-up period in an endurance test.

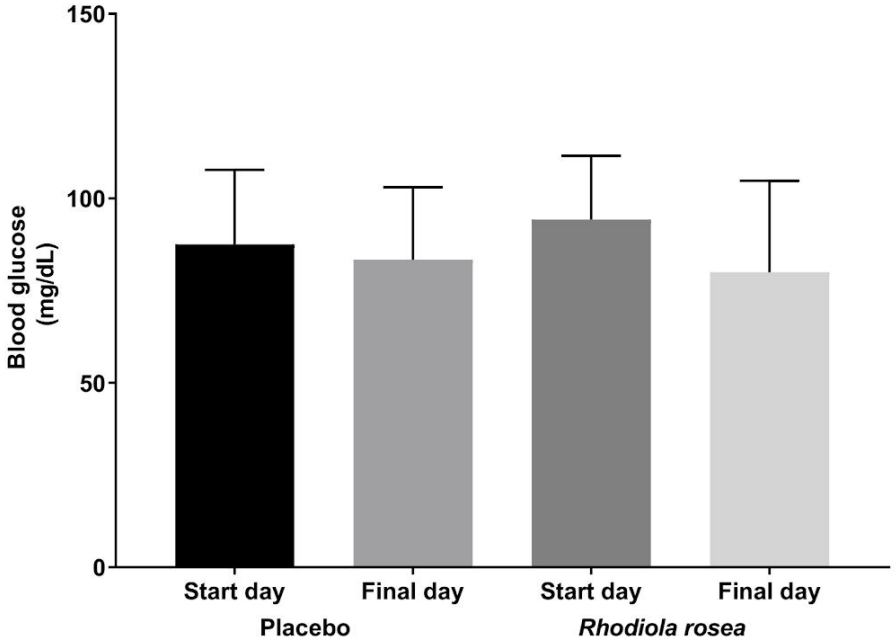
It can be inferred, therefore, that the use of the examined herbal remedy did not result in any evident cardiometabolic changes. This finding suggests, at least theoretically, that individuals with heart diseases may benefit from the therapeutic effects of *R. rosea*, such as improved performance during physical activities and reduced fatigue.

Following the same line of reasoning as the preceding conclusions, the glycemic measurements of the volunteers over the period of exposure to the herbal remedy did not exhibit significant changes, covering the interval between the first and last day of treatment. This same pattern was observed during the placebo administration period (Figure 4).

Thus, it is possible to infer that exposure to *R. rosea* did not cause substantial changes in glycemic concentrations. This finding, even from a hypothetical perspective, suggests the feasibility of considering the mentioned herbal remedy as a safe alternative for administration in diabetic individuals concurrently treated with hypoglycemic medications.

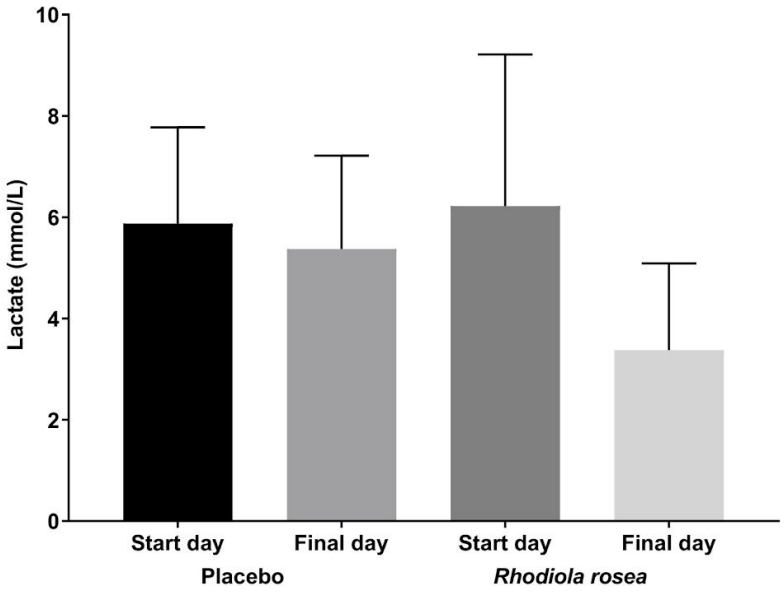
Analyzing the results of the study by Parisi et al 13 regarding glycemic levels, no significant differences were observed between the four-week supplementation with *R. rosea* and the placebo. This observation can be attributed to the ability of *R. rosea* supplementation to increase the utilization of fatty acids, both at the peak of effort and during the recovery period, thereby preserving glycogen. This mechanism, in turn, may favor a more effective recovery after exercise.

Figure 4. Glycemia assessment between the placebo and test *(Rhodiola rosea)* groups between the initial and final days of treatment application (n=25).



Unlike what was observed in the previous analyses, the exposure of volunteers to treatment with standardized dry extract of *R. rosea* resulted in significant variations in lactate levels when comparing the last day of exposure to *R. rosea* with the last day of exposure to the placebo. Furthermore, a notable reduction was observed in lactate levels between the beginning of the herbal treatment and the last day of exposure (Figure 5). An investigation in literature, employing *R. rosea* supplementation for a four-week period in a clinical trial with athletes undergoing a cardiopulmonary exhaustion test, also reported significantly lower levels of lactate and creatine kinase, indicating that supplementation could reduce lactic acid production [13].

Figure 5. Lactate assessment between the placebo and test (Rhodiola rosea) groups between the initial and final days of treatment application (n=25).

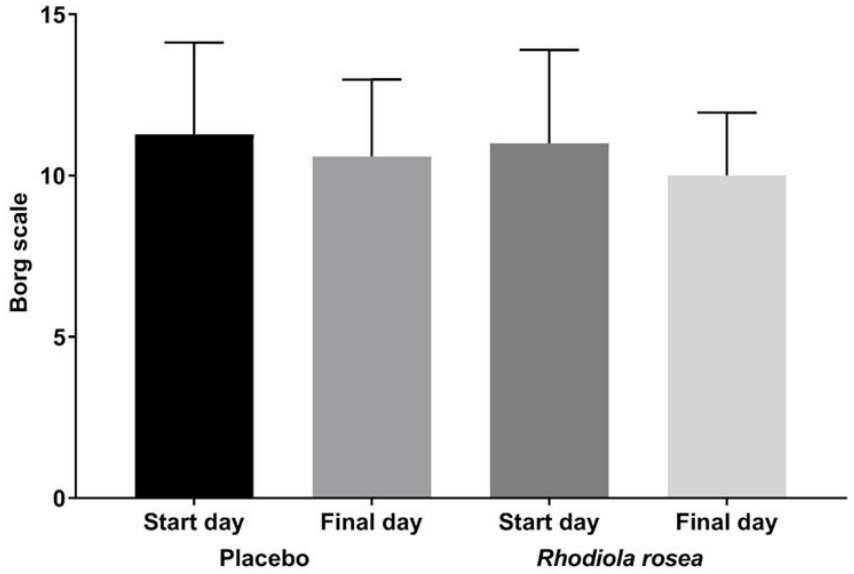


Exhaustion, which can be induced by levels of stress both physical and mental, is a fundamental precursor to the development of fatigue. Physical exercise, for example, could cause injuries to skeletal muscle cells, increase the production of reactive oxygen species, disrupt pH, and result in acidosis, notably through the elevation of lactate. This process, called exercise-induced oxidative stress, must be counteracted when the goal is to enhance the fitness and performance of physical activity practitioners. A possible explanation for the reduction in lactate levels in individuals

supplemented with *R. rosea* lies in the concentration of flavones and phenolic acids, as well as other powerful antioxidants that would mitigate the action of free radicals [14,15].

Another aspect addressed in this study was the perceived effort by volunteers during evaluations, quantified and recorded on a subjective scale of effort perception. The analysis of the collected data revealed that, despite reflecting individual perceptions, the results did not show significant variations between the volunteers who received treatment with *R. rosea* compared to those who received the placebo (Figure 6). Similarly, Parisi *et al* [13] also found similar results in their studies, where they assessed the intensity, fatigue, and perceived effort by athletes during the test, using the Borg Scale, after the use of both *R. rosea* and the placebo.

Figure 6. Evaluation of subjective perception of effort according to the Borg scale between the placebo and test (Rhodiola rosea) groups between the initial and final days of treatment application (n=25).



However, there is a point of interpretation that is quite discordant; the perception of effort, in principle, reflects the physiological stress derived from variables such as exercise intensity, lactate levels, and heart rate. In the context of steady-state exercise, a gradual increase in perceived effort would only be discernible if the effort intensity were increased to a point that unbalanced such variables. This, in turn, puts into perspective the limited utility of this method [16].

Rhodiola rosea emerges as an agent that exhibits adaptogenic properties in various physiological processes and metabolic mechanisms, stimulating the utilization of fatty acids, imparting ergogenic function, and enhancing the body's resistance to strenuous physical efforts. However, its mechanism of action remains largely enigmatic. Studies have correlated the use of this herbal remedy with modifications in the hypothalamic-pituitary-adrenal axis and stress mediators, but further investigations are needed to more precisely unravel the benefits and applications of *Rhodiola rosea* [17,18].

4. CONCLUSION

The results suggest that supplementation with *R. rosea* may be useful in sports activities, especially in endurance and resistance sports, in order to neutralize physiological changes. The preliminary conclusions of this study should be extended to a larger number of subjects, aiming to confirm the results obtained so far and even to have a clearer understanding of other possible effects of *R. rosea*.
We can observe an improvement in the physical conditioning of this group, even in a short period of extract use, without affecting glycemia or cardiac parameters, thus making it a promising plant for use in physical activity.

CONSENT

Ethical approval for this study was granted by the Research Ethics Committee for Human Subjects at the Federal University of Tocantins (approval number: 2,891,986). Additionally, written informed consent was obtained from all

participants involved in the clinical trial. The privacy and confidentiality of participants' data were strictly maintained during and after the study.

ETHICAL APPROVAL

The research project and the Informed Consent Form were submitted and approved under reference number 2.891.986 by the Research Ethics Committee for Human Subjects at the Federal University of Tocantins.

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