Original Research Article

Evaluation of the therapeutic of 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 perennial herbaceous plant belonging to the Crassulaceae family [1]. It is predominantly found in cold regions of Europe, Asia, and North America, where it grows at high altitudes, in rocky soils and mountainous areas [2]. Over the centuries, *R. rosea* has been utilised in traditional medicine practices across various cultures, being recognised for its multiple therapeutic properties, including enhancing physical endurance, improving mental performance, promoting longevity, and treating various health conditions such as fatigue, depression, anaemia, sexual impotence, gastrointestinal disorders, infections, and diseases of the nervous system [3,4,5].

Scientific studies have shown that *Rhodiola rosea* possesses adaptogenic properties [6], meaning it has the ability to regulate and improve the body's response to both physical and psychological stress. Among the most prominent

activities of this plant are its neuroprotective, anti-fatigue, and stimulating properties for the central nervous system. These effects appear to be related to the modulation of the Hsp70 protein, an important cellular protection mechanism, which reduces the expression of the gene responsible for nitric oxide (NO) production and interacts with glucocorticoid receptors, leading to a reduction in circulating levels of NO and cortisol, hormones involved in the stress response [7]. These effects contribute to improved physical endurance and the body's recovery capacity, especially in situations of prolonged or extreme stress.

The phytochemical composition of *R. rosea* is rich in various bioactive compounds, such as phenolics, propanoids, and flavonoids [8]. Among the main active components identified are salidroside, tyrosol, rosarin, rosin, rosavin, as well as essential oils like decanal and geraniol [9]. These compounds are responsible for the observed therapeutic effects, particularly in relation to increased physical endurance and improved cognitive performance. However, to confirm and validate these properties, it is essential to conduct further clinical studies involving different population groups and settings, aiming to provide more robust data on the efficacy and safety of *R. rosea* in a therapeutic context.

Therefore, the aim of this study was to assess the efficacy of the oral administration of *R. rosea* dry extract in individuals engaging in physical activities. This study aims to contribute to the understanding of the potential impact of this plant on improving physical performance, endurance, and recovery, with an emphasis on scientific evidence of its benefits for regular physical activity practitioners.

2. MATERIAL AND METHODS

This study is designed as a double-blind, randomised clinical trial. A total of 25 participants were randomly assigned to one of two groups: the PLA group, which received a placebo, and the RhR group, which was given the extract of Rhodiola rosea. In this double-blind design, neither the researchers conducting the study nor the participants were aware of the group allocations.

The standardized dry extract of *Rhodiola rosea* was compared to a placebo, consisting of starch, in a sample of volunteer runners from the city of Palmas, Tocantins. The preparation of these formulations was carried out in a licensed and certified pharmaceutical compounding facility, in compliance with local regulations in Palmas, Tocantins. The experimental protocol used in this study was adapted from previous research, specifically the study by Noreen et al. [2]. Furthermore, the study adhered to the guidelines set forth 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 study involved 25 volunteers of both genders, all of whom participated in running activities three times a week. The participants were randomly assigned to two groups, as outlined in Table 1. In the first week (Treatment 1), Group 1 was given a placebo (Sample A) for 7 days, followed by a 7-day cleansing period. During the second treatment (Treatment 2), Group 1 was then administered *R. rosea* (Sample B) for 7 days. Group 2 followed a reversed order, receiving Placebo Sample B in the first treatment and Sample A in the second.

Table 1. Experimental protocol, demonstrating the number of participants, type of treatment (placebo and plant sample), duration of the treatment period, and the interval between interventions.

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, 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). These assessments were conducted to evaluate cardiovascular responses to physical exertion. In addition to these measurements, capillary glucose and lactate levels were assessed using portable devices, specifically the Accu-Chek Active® for glucose and the Accutrend® Plus for lactate, to monitor metabolic responses to exercise. Furthermore, participants' perceived levels of exertion were assessed following the exercise session using the Borg Scale, which operates on a numerical scale ranging from 6 to 20 points [11,12] (Borg, 1998, 2000). Prior to the test, participants were provided with verbal instructions on how to rate their exertion levels, ensuring consistency and accuracy in the self-reported data. These assessments were crucial for evaluating the physiological impact of the interventions on the participants' physical performance and recovery.

The data collected were systematically organized and recorded in spreadsheets for further analysis. All statistical analyses were performed using GraphPad Prism 8.0 software. Descriptive statistics were first employed to summarize the data and provide an overview of the distributions and central tendencies within each group. To assess the differences between groups, analysis of variance (ANOVA) was conducted, followed by the Tukey post-hoc test for multiple comparisons of the group means. The analyses were conducted with a significance level set at $p < 0.05$. This approach allowed for the identification of significant differences between the groups in relation to the measured outcomes. The use of these statistical methods ensured a robust analysis of the data, providing reliable insights into the effects of the interventions on the participants' performance and physiological responses.

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.

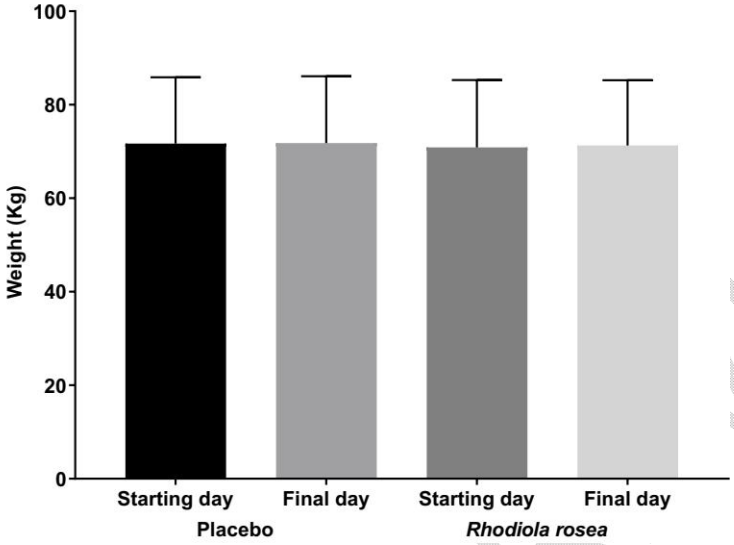
Table 2. Characteristics of research participants.

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 duration of the testing period, it is crucial to emphasize that it cannot be concluded that the use of the herbal remedy resulted in weight reduction for therapeutic purposes. Therefore, it is important to underscore that, despite the occasional marketing of this phyto-medicinal agent for weight loss, there is, at present, no substantial scientific evidence to support such claims. Additionally, all participants were instructed to maintain their regular dietary habits and exercise routines, ensuring no alterations in their daily activities or exercise intensity, thereby minimizing the potential for biases in the results observed in this study.

In terms of blood pressure measurements (Figure 2) taken across the various groups, no significant changes were observed between the baseline and final stages of each treatment phase. This finding was consistent when evaluating heart rate across both the initial and final stages of each treatment phase. Furthermore, no meaningful differences were identified when comparing the placebo group with the group receiving *R. rosea* treatment (Figure 3). These results indicate a lack of noteworthy physiological changes in blood pressure and heart rate in response to the supplementation during the study period.

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.

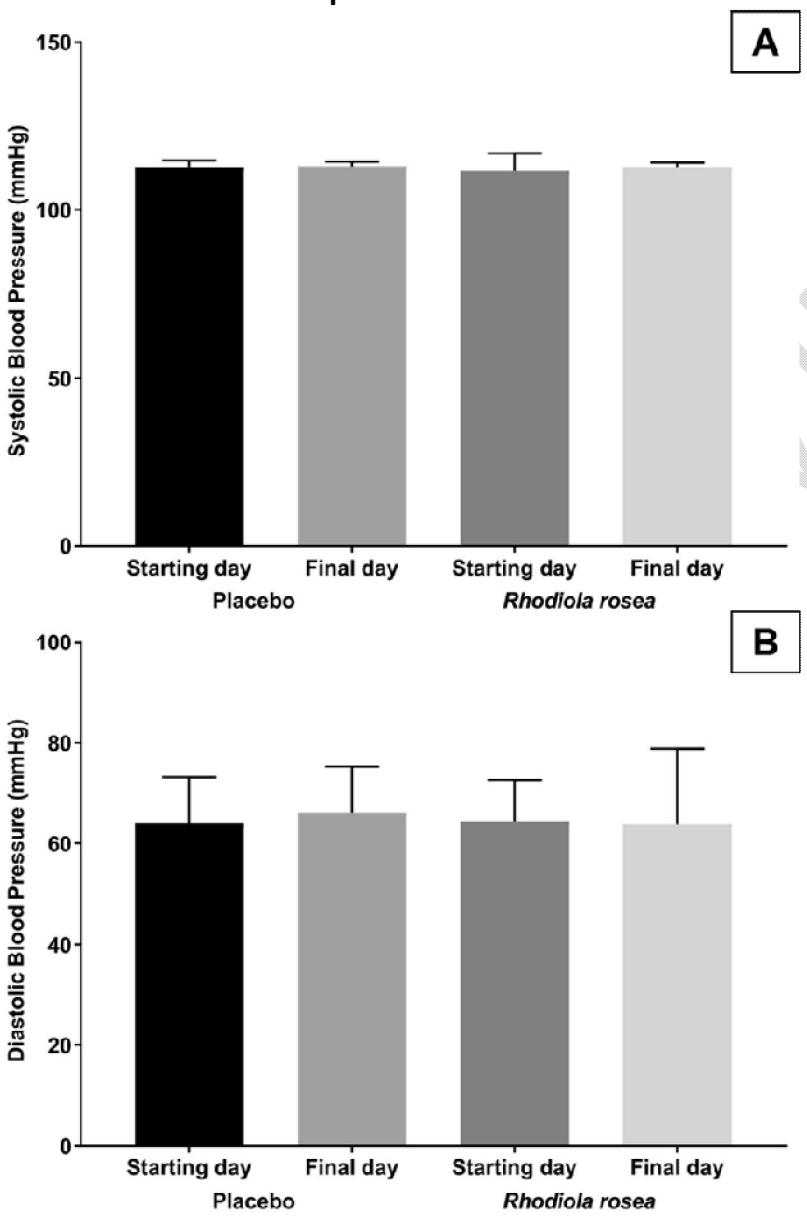
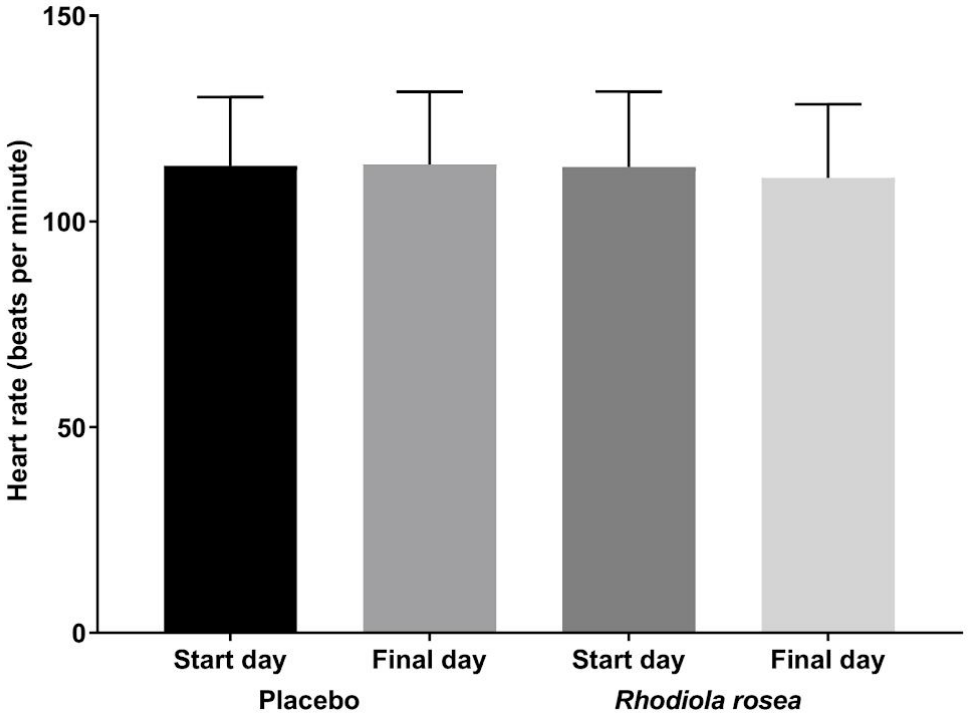


Figure 3. Evaluation of heart rate between the placebo and test (*Rhodiola rosea*) groups between the initial and final days of treatment application (n=25).

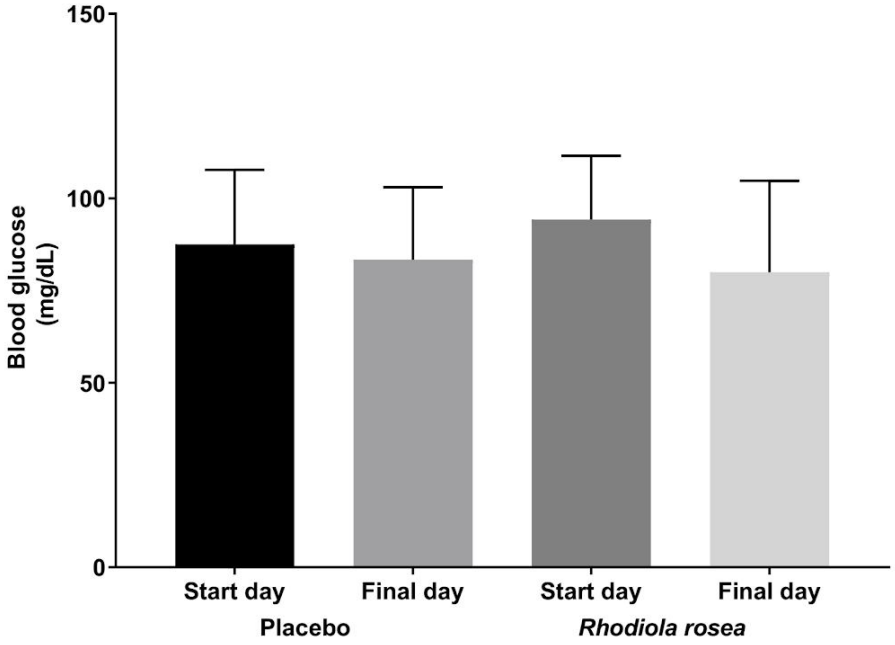


To assess the effects of chronic supplementation with R. rosea over a four-week period on athletic performance in endurance athletes, Parisi et al. (13) conducted a clinical trial. The results from this study revealed that the measured parameters showed no significant changes compared to those resulting from placebo treatment. Specifically, heart rate remained essentially unchanged in both groups. In contrast, Noreen et al. (14) observed different results, with *R. rosea* supplementation leading to a notable reduction in heart rate during a moderate warm-up phase of an endurance test. These findings suggest that the use of *R. rosea* did not induce significant cardiometabolic changes. This could imply, at least theoretically, that individuals with heart conditions might benefit from the therapeutic effects of R. rosea, such as improved physical performance and reduced fatigue during exercise.

In line with these conclusions, the glycemic measurements of the participants throughout the exposure period to the herbal remedy did not show any significant alterations, including the interval between the first and final day of treatment. This same trend was observed during the placebo administration period (Figure 4). Therefore, it can be inferred that exposure to R. rosea did not cause substantial changes in glycemic levels. From a theoretical standpoint, this finding suggests that R. rosea may be considered a safe alternative for use in diabetic individuals who are concurrently treated with hypoglycemic medications.

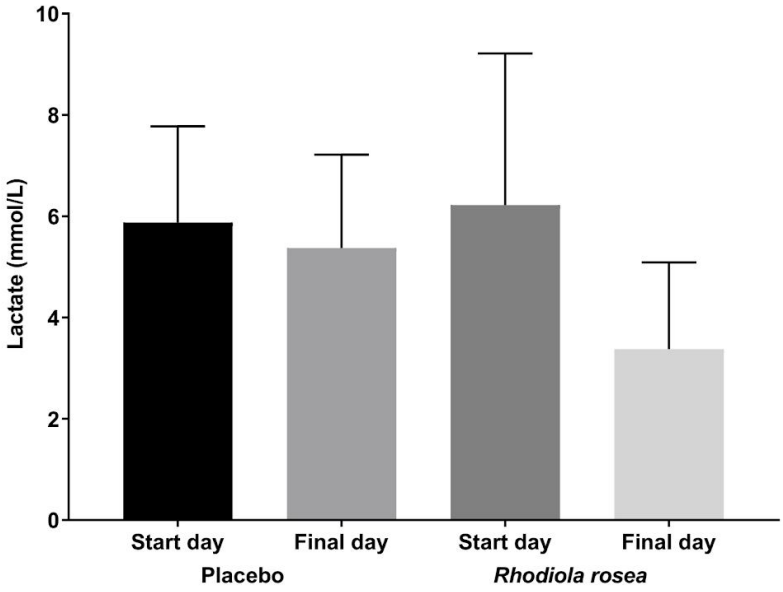
Upon analyzing the results of the study by Parisi et al. (13) regarding glycemic levels, no significant differences were found between the four-week supplementation with *R. rosea* and the placebo. This observation can likely be attributed to the ability of *R. rosea* supplementation to enhance the utilization of fatty acids, both during peak effort and throughout the recovery phase. By promoting the use of fatty acids, *R. rosea* may help preserve glycogen stores, which, in turn, could contribute to a more efficient 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).



As observed in previous studies, the exposure of volunteers to treatment with the standardized dry extract of *R. rosea* resulted in significant changes in lactate levels. When comparing the last day of exposure to *R. rosea* with the last day of exposure to the placebo, a marked reduction in lactate levels was observed. Additionally, a notable decrease in lactate levels was evident between the start of the herbal treatment and the last day of exposure (Figure 5). A similar study in literature, involving a four-week supplementation of *R. rosea* in athletes undergoing a cardiopulmonary exhaustion test, also reported significantly lower levels of lactate and creatine kinase. These findings suggest that supplementation with *R. rosea* may potentially reduce lactic acid production, thereby improving athletic performance and recovery [13].

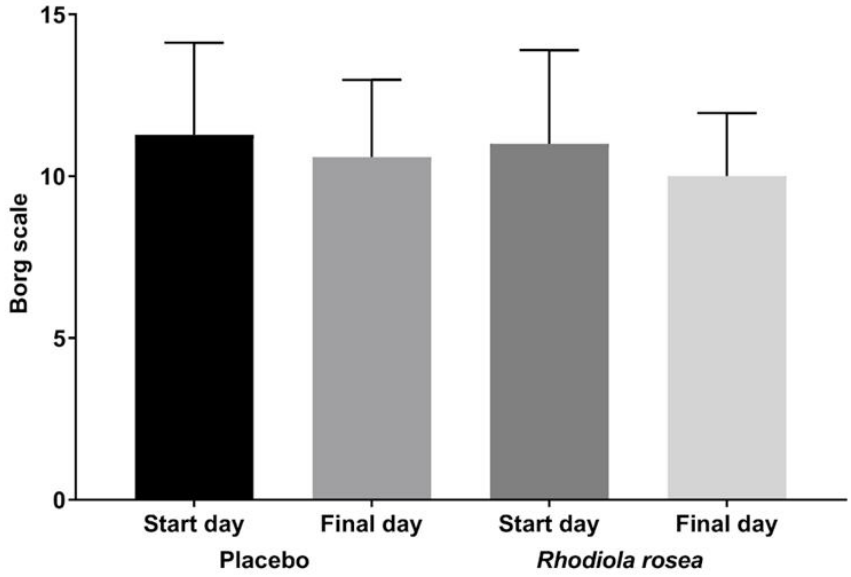
Figure 5. Lactate assessment between the placebo and test (Rhodiola rosea) groups between the initial and final days of treatment application (n=25).



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 benefit endurance and resistance sports by mitigating physiological changes associated with physical exertion. Although the study was conducted over a short period, it showed improvements in physical condition without affecting glycaemia or cardiac parameters. These preliminary findings support the potential of *R. rosea* as a promising supplement for physical activity, but further studies with a larger sample size are needed to confirm these results and explore its broader effects.

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ETHICAL APPROVAL AND 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.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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