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Research Article

Effects of *Lignosus rhinocerus* and *Eurycoma longifolia* on Aerobic Exercise Performance, Rate of Perceived Exertion and Heart Rate in Young Athletes

Chee Ping Fadzel Wong* and Lau Ngikk Ling

Faculty of Food Science and Nutrition, University Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu, Sabah, Malaysia

Abstract

Ergogenic supplements are widely used by athletes to enhance sports performance, yet scientific evidence supporting their efficacy remains variable. *Lignosus rhinocerus* and *Eurycoma longifolia* are traditional herbal supplements purported to improve physical fitness and metabolic function. However, data on their combined effects of *Lignosus rhinocerus* and *Eurycoma longifolia* on aerobic performance are scarce. This study aimed to examine the impact of combined supplementation with *Lignosus rhinocerus* and *Eurycoma longifolia* on aerobic exercise performance, rate of perceived exertion and heart rate in young male athletes. Eight young male athletes completed a randomised and crossover study, receiving either the supplement combination or a placebo for six consecutive days, with an additional acute dose administered one hour before an aerobic exercise test. Time to complete the aerobic exercise test, rate of perceived exertion and heart rate were recorded during each trial. A one-week washout period separated the two trials to minimise carryover effects. Data were analysed using repeated-measures ANOVA and paired t-tests, and are presented as mean ± SD. This study found that combined supplementation of *Lignosus rhinocerus* and *Eurycoma longifolia* had no significant effect on aerobic exercise performance, rate of perceived exertion and heart rate compared with the placebo. Both the rate of perceived exertion and heart rate increased significantly from baseline in all trials, consistent with expected physiological responses to exercise. These findings suggest that six days of supplementation of *Lignosus rhinocerus* and *Eurycoma longifolia*, including an acute pre-exercise dose, is insufficient to elicit measurable ergogenic benefits in young athletes. Future research should explore longer supplementation durations and varied dosages to determine potential performance-enhancing effects.

More Information

***Corresponding author:** Chee Ping Fadzel Wong, Faculty of Food Science and Nutrition, University Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu, Sabah, Malaysia, Email: fadzel@ums.edu.my

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Keywords: *Lignosus rhinocerus*; *Eurycoma longifolia*;, Aerobic exercise; Heart rate; Rate perceived of exertion; Ergogenic supplements and young athletes

Introduction

Lignosus rhinoceros has long been used by indigenous communities in Southeast Asia to promote general health and improve physical stamina [1]. In Malaysia, it is commonly known as *Cendawan Susu Rimau* [2]. The health-promoting properties of *Lignosus rhinoceros* have been documented, especially about its antioxidant potential [3,4]. *Eurycoma longifolia* is more widely known as Tongkat Ali or Long Jack. It is a native herbal plant found predominantly in Malaysia, Indonesia and Vietnam [5]. It is often referred to as "Malaysian Ginseng," and traditionally used as an adaptogen to combat stress, improve vitality and enhance physical strength [6,7]. *Eurycoma longifolia* has been associated with various therapeutic properties, including aphrodisiac, antimalarial, cytotoxic, antipyretic and anti-ulcer effects [5].

Antioxidants may reduce free radical accumulation, thereby limiting exercise-induced oxidative stress, which is a major contributor to muscle damage and fatigue [8]. Tan, et al. [3] reported that consuming 300 mg of *Lignosus rhinocerus* twice daily for three months increased total antioxidant capacity by approximately 70%. Fung and Tan [4] observed improvements in stamina, alertness, and respiratory function following a two-week intake of 500 mg of *Lignosus rhinoceros*. *Eurycoma longifolia* has been widely promoted for its potential ergogenic effects, particularly relating to hormonal regulation and muscle strength [9]. Talbott, et al. [10] found that 100 mg of *Eurycoma longifolia* consumed 30 minutes before intense endurance exercise reduced cortisol levels by 32.3% and increased testosterone levels by 16%. This suggests an enhanced anabolic hormonal environment during exercise.

Chen, et al. [11] further demonstrated that six weeks of 400 mg/day supplementation increased testosterone without exceeding the IOC-regulated testosterone-to-epitestosterone ratio of 4:1.

Multi-ingredient pre-workout supplements (MIPS) have also grown in popularity for their potential synergistic effects on exercise performance [12]. Despite individual evidence supporting *Lignosus rhinocerus* and *Eurycoma longifolia* as performance-enhancing supplements, research on their combined effects, particularly over a short-term supplementation period, has remained limited. It is therefore hypothesised that combining these two supplements may produce synergistic benefits for aerobic exercise performance. Thus, the objective of this study was to determine the effects of combined *Lignosus rhinocerus* and *Eurycoma longifolia* supplementation on aerobic exercise performance, rate of perceived exertion and heart rate in young athletes.

Methodology

Selection of participants

Eight young male athletes aged 19–29 years were recruited through random sampling from the athlete population. Exclusion criteria included hypertension, asthma, diabetes, bronchitis, anaemia, cardiac conditions, kidney or liver disease, and other major medical conditions. The full study protocol was explained to all participants. Participants completed demographic, lifestyle, and medical history questionnaires, as well as the International Physical Activity Questionnaire (IPAQ). Anthropometric measurements were collected during a pre-trial session.

Experimental design

1. A randomised crossover design was employed. Each participant completed a 2.4 km aerobic run test under two conditions:Supplement trial – daily consumption of 250 mL of water mixed with 5 g of powdered *Lignosus rhinocerus* and *Eurycoma longifolia* for six days.

2. Placebo trial – daily consumption of 250 mL plain water for six days.

A seven-day washout period separated the two trials, and trial order was randomised.

Preparation of participants

Participants recorded their food intake for three days before the first trial and replicated the same dietary pattern before the second trial to control for variations in muscle glycogen levels. They were also instructed to avoid strenuous physical activity for at least 24 hours before each running test.

Trial procedure

Upon arrival on test day, the resting heart rate was measured. A chest-strap heart rate monitor was fitted to record heart rate continuously throughout the run. Participants consumed either the supplement or the placebo drink one hour before the 2.4 km run. Time to completion aerobic exercise test, rate of perceived exertion and heart rate were recorded before and after each trial.

Statistical analysis

Data were analysed using SPSS version 29.0 (SPSS Inc., United States). All outcomes were expressed as mean ± standard deviation. Repeated-measures ANOVA and paired t-tests were used to identify differences between supplement and placebo trials, with significance set at $p < 0.05$.

Results and discussion

The participants' body mass index (BMI) and waist-to-hip ratio (WHR) fell within the normal, healthy range (Table 1). These anthropometric values suggest that the participants were generally of normal body composition, with no indications of overweight, obesity, or central adiposity. Maintaining BMI and WHR within recommended ranges is important, as both indicators are commonly used to assess overall fitness level, metabolic health and the risk of developing cardiovascular or obesity-related conditions.

There was no significant difference in the time taken to complete the aerobic exercise test between the supplement and placebo trial ($p > 0.05$) (Figure 1).

Heart rate and rate of perceived exertion (RPE) are presented in Figure 2. Both parameters showed significant increases over time within each trial compared with their respective resting values ($p < 0.05$). However, no significant

Table 1: Physical characteristics of the participants.

Physical characteristics of the participants ($n = 8$)	Mean ± SD
Height (cm)	171.89 ± 4.53
Weight (kg)	65.30 ± 10.00
BMI (kg/m^2)	22.03 ± 2.79
Waist circumference (cm)	82.90 ± 5.32
Hip circumference (cm)	96.97 ± 7.04
Waist-to-hip ratio (WHR)	0.85 ± 0.31

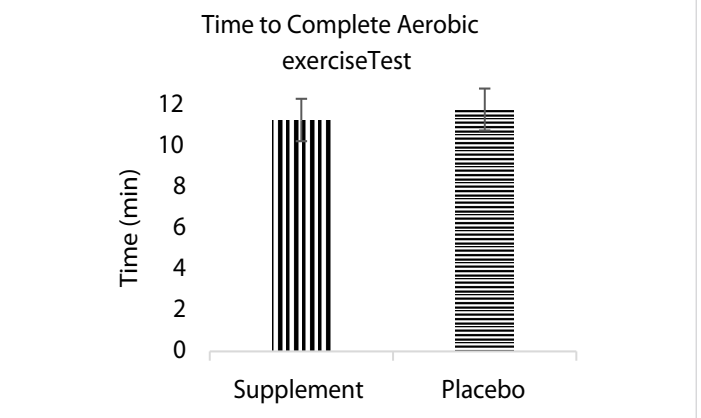

Figure 1: Time to complete the aerobic exercise test in the supplement and placebo trials. Data is presented as mean ± SD.

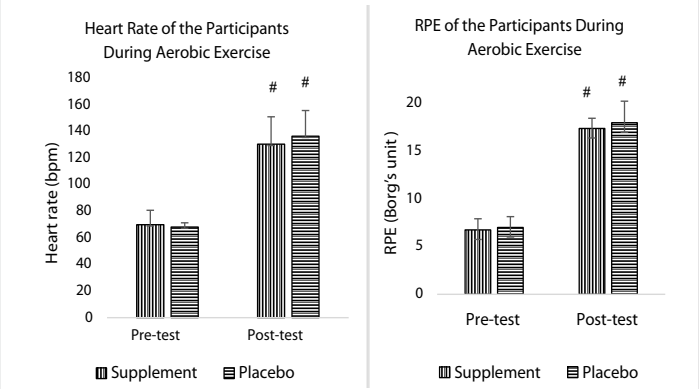

Figure 2: Heart rate and rate of perceived exertion of the participants during aerobic exercise in the supplement and placebo trials. Data is presented as mean ± SD. #denotes significant difference from respective pre-test values at $p < 0.05$.

differences were observed between the two trials for any of these measures. The rise in heart rate during running was consistent with the expected cardiovascular response to dynamic exercise. As running intensity increases, the body must elevate cardiac output and redistribute blood flow to meet the heightened metabolic demand for oxygen and nutrients in the working skeletal muscles, enabling the continuous production of adenosine triphosphate (ATP) to sustain movement. Additionally, sympathetic nervous system activation likely contributed to these cardiovascular adjustments. Participants reported their perceived exertion using Borg's Rate of Perceived Exertion (RPE) scale. RPE values increased progressively throughout the exercise in both trials, reflecting the rising physical strain and aligning with the physiological markers of effort. The significant increase in RPE indicates that participants approached volitional fatigue by the end of the running protocol. No significant differences in RPE responses were found between the two trials, suggesting similar subjective perceptions of effort under both conditions.

The main finding of the present study was that supplementation with a combination of *Lignosus rhinocerus* and *Eurycoma longifolia* for six days, including a single dose taken one hour before the aerobic exercise test, did not produce significant improvements in aerobic exercise performance among young athletes. To the best of our knowledge, this is the first study to examine the potential synergistic effects of *Lignosus rhinocerus* and *Eurycoma longifolia* on aerobic exercise performance using a field-based running protocol in Malaysian young athletes. The present findings align with previous research reporting no ergogenic effects of these supplements on sport performance [13-16]. Zakaria, et al. [13] found that seven days of *Lignosus rhinocerus* supplementation (100 mg/day) did not significantly enhance peak force, peak power, countermovement jump height, drop jump reactive strength index (RSI) and perceived muscle soreness. Similarly, Chen, et al. [14] observed that *Lignosus rhinocerus* supplementation combined with resistance training failed to improve aerobic or anaerobic fitness, isokinetic strength, muscle power and immune markers in young men. Muhammad, et al. [15] also reported no significant improvements in endurance running after seven days of *Eurycoma longifolia* supplementation (150 mg/day). Likewise, Ooi, et al. [16] found no enhancement in endurance cycling when cyclists ingested an herbal drink containing *Eurycoma longifolia* during exercise.

Despite these consistent findings, several studies have reported contrasting results, suggesting that *Eurycoma longifolia* may enhance physical performance when supplemented over a longer duration [17,18]. Hamzah and Yusof [17], for instance, reported significant increases in muscular strength following five weeks of supplementation with 150 mg of *Eurycoma longifolia* in healthy male adults. *Eurycoma longifolia* contains bioactive quassinoids that have been associated with increased muscle strength, reduced anxiety and stress and potential improvements in overall physical performance [18]. These findings suggest that *Eurycoma longifolia* may exert more pronounced ergogenic effects in strength- and power-oriented activities rather than endurance-based performance, which relies more heavily on aerobic metabolism and cardiovascular efficiency.

Previous studies have also highlighted the antioxidant, anti-inflammatory, antihypertensive, and antimicrobial properties of both *Lignosus rhinocerus* and *Eurycoma longifolia* [3,18,19]. Tan, et al. [3] demonstrated that *Lignosus rhinocerus* supplementation improves respiratory health and immune function, which are potentially beneficial attributes for athletes engaged in prolonged aerobic activity. *Eurycoma longifolia*, on the other hand, contains glycoproteins and eurycomanone, compounds associated with anti-ageing effects and increased androgenic activity, including elevated testosterone levels. Testosterone plays a critical role in enhancing bone density, muscle strength and overall performance capacity [6,20]. It is well established that intense or prolonged exercise increases oxidative stress due to elevated production of free radicals, which can impair muscle contraction, accelerate fatigue, contribute to muscle damage and compromise sports performance [21]. Antioxidants are essential in neutralising these free radicals, thereby reducing oxidative damage, mitigating fatigue and potentially improving performance [8]. Many athletes consume antioxidant-rich supplements to reduce muscle soreness, prevent immune suppression and maintain optimal training quality [22]. Based on these physiological mechanisms, it was initially hypothesised that the antioxidant properties of *Lignosus rhinocerus* and *Eurycoma longifolia* would enhance aerobic exercise performance by reducing exercise-induced oxidative stress.

However, the present study did not support this hypothesis. The absence of significant improvements may be attributed to the short duration of supplementation, which may not have been sufficient to induce meaningful physiological adaptations or to accumulate the bioactive compounds required to exert measurable ergogenic effects. It is also possible that the

dosage used, the training status of the athletes, or individual variability in supplement response influenced the outcomes. Therefore, future studies are recommended to employ longer supplementation periods and varied dosages to determine whether more robust and sustained physiological adaptations can improve aerobic exercise performance when using these supplements [23-28].

Conclusion

In conclusion, although *Lignosus rhinocerus* and *Eurycoma longifolia* are commonly promoted for their potential synergistic benefits on sports performance, the present study demonstrated that six days of daily supplementation together with a single pre-exercise dose taken one hour before the endurance running test did not produce any significant improvements in aerobic exercise performance, rate of perceived exertion and heart rate responses in young male athletes. These findings suggest that short-term supplementation with these herbal compounds is insufficient to elicit measurable ergogenic effects during aerobic exercise. Further research involving longer supplementation periods and different dosages is warranted to clarify their potential role in enhancing aerobic exercise performance among young male athletes.

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