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The Effect of Cinnamon Extract on Recovery and Performance of Weightlifting Athletes

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Abstract

Weightlifting is a type of sport that demands beneficial complementary supplements. This is because of the highly intensive training and tight schedules, which requires the body to be maintained at the prime condition to avoid injury. Furthermore, supplements and natural products are needed to accelerate athletes' recovery and avoid doping. Cinnamon is a good natural product that contains phenol and cinnamaldehyde antioxidant content. This study used a double-blind one-way crossover design approach on 16 male athletes with the lowest experience competing in Southeast Asia. The athletes consumed 500 mg of cinnamon extract for 8 weeks and entered a 4 and 8 week washout phase and placebo, respectively. The performance tests were conducted by match simulations, such as snatch and clean and jerk. Creatine kinase (CK), C-reactive protein (CRP), and lactate were tested to determine fatigue levels and accelerate recovery. According to the results, significant changes occurred for CK and CRP of $p<0.005$, glucose $p<0.048$, and lactate at $p<0.012$ with no effects on performance. Conclusion: Cinnamon extract significantly affects CK, CRP, lactate, and glucose without any notable effects on performance.

Keywords: *Ergogenic aid, Muscle damage, Muscle soreness*

Introduction

Young athletes go through many growth stages from an early age to become professionals and achieve peak performance (Huebner, & Perperoglou, 2019). Some athletes exercise 12 times a week, impacting their fatigue levels, recovery speed, and performance of future activities (Williams, Tolusso, Fedewa, & Esco, 2017; Poulios et al., 2019; Junaidi et al., 2020). Even in weightlifting, the risk of injury to young athletes is more or less due to imperfect technique. On the other hand, they should continue to practice regularly with the measured load. The main problem is the wrong technique when exercising often affected by fatigue condition. Fatigue experienced by weight lifters after training causes muscle soreness and damage because, after exercise, there are inflammations caused by C-Reactive Protein (CRP), and intracellular proteins, such as creatine kinase (CK) (Magal et al., 2010; Araszi & Asadi, 2013). This inflammatory state often results in muscle soreness, decreased functionality, and reduced performance (Peternelj & Coombes, 2011; Powers, Nelson, & Hudson, 2011; Chen et al., 2012).

Athletes should consume food and drinks with sufficient nutritional content to meet their body requirements. Some athletes and coaches prepare supplements from natural and synthetic ingredients to meet their needs before and after training. Athletes aim to accelerate muscle recovery and increase energy when training (Braun et al., 2009). Natural-based supplements help increase antioxidants and anti-fatigue in the body, improving an athlete's performance (Peternelj, & Coombes, 2011; Zhu et al., 2020). Cinnamon extracts can reduce muscle damage caused by insulinogenic effects when administered in 500 mg daily dosage in 6 consecutive weeks (Zhu et al., 2020). In that study, the samples were badminton athletes, who tended aerobic metabolic characteristics. Furthermore, studies on cinnamon conducted in 2020 show that it can reduce muscle inflammation and oxidative stress levels in humans (Zhu et al., 2020). That reasonable because, they study explain cinnamon contents include 3-phenyl-2 (E) -propenal aromatic aldehyde (cinnamaldehyde, trans-cinnamaldehyde) and cinnamic acid. Other benefits of cinnamon are often used for alternative and

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complementary medicine. Cinnamon intake has been used because of its therapeutic effect in treating flatulence, diarrhea, toothache, fever, vaginal discharge, flu, headaches, as well as an antitumor and anticancer (Kawarta, & Rajagopalan, 2015; Goel, & Mishra, 2020). However, other studies have shown unclear findings on muscle improvement after consuming cinnamon extract. Moreover, the physiological effects, such as CRP and glucose, are still lacking. Therefore, the effect of cinnamon extract on insulin sensitivity, inflammation, increased glucose transport in skeletal muscle, and improved recovery is unclear.

No studies have shown the effects of cinnamon extract on accelerating the recovery process with indicators of muscle soreness and damage, as well as athletic performance. Therefore, this study examined the effect of cinnamon extract for 8 consecutive weeks on physiological biomarkers such as muscle soreness and damage, as well as increased performance in weight lifters. The study hypothesized that the 8-week supplementation period of the cinnamon extract significantly improves athlete performance and reduces muscle soreness and damage.

Methods

Study design and participant

The design of this study was double-blind one-way crossover to determine the effect of cinnamon extract on muscle soreness and damage, as well as performance on 16 weightlifters. This study involved 16 male athletes under the guidance of the Gajah Lampung weightlifting club. All samples were recruited based on the different criteria, including having participated twice in national weightlifting championships, non-smoker, and no history of chronic diseases. Moreover, during the treatment, participants were prohibited from consuming anything outside the research rules, including food and drink supplements. The samples filled an informed consent to participate and all research procedures were approved by the ethics committee of the Indonesian Ministry of Health. Also, the research protocol received ethical approval from the Health Research Ethics Committee, Ministry of Health, Bandung Health Polytechnic, Letter No. 10/KEPK/EC/IV/2020.

All samples were prohibited from taking supplements 4 weeks before the initial test and the treatment stage to avoid routine consumption effects, and then the participants received 8 weeks of treatment for the first cinnamon extract supplementation. This was followed by a 4- and 8-week washout and second supplementation period with placebo respectively. In the first stage, samples consumed a 250 mg-capsule of cinnamon extract (Cinnulin PF®, 4 All Vitamins, New York, USA) every morning and evening. The second supplementation stage used a placebo without anti-fatigue and antioxidants with the same consumption time and duration, as explained in Figure 1. Cinnamon extract and placebo dosages were established based on previous study (McMorris et al., 2006).

Settings and locations of data collection

The research was conducted in Lampung, Indonesia. Testing took place on Prodia Laboratory in Bandar Lampung City. The baseline study was started in June 2020 and ended in October 2020.

Outcome measures

In this study, the training program is controlled by a team of trainers who ensure that all samples get an exercise program with the same goals customized to their respective abilities. Furthermore, a certified nutritionist provided food for all daily meals and fluids. This was to ensure that the samples were not contaminated by nutritional intake outside the control, resulting to study disruptions. Nutritional control was easier because all samples were in the same dormitory, and the research team could quickly review their daily activities.

All participant takes arthrometric tests, including body height, body weight, and body composition measured using DEXA composition before starting supplementation. Furthermore, the samples were taken for lactate and glucose levels, creatine kinase (CK), and C-Reactive Protein (CRP) measurements. After a performance test conducted comprising of clean and jerk, snatch, and 1 Repetition Maximal (1RM). Lactate and glucose levels, creatine kinase (CK), and C-Reactive Protein (CRP were taken within 24 hours after the previous tests. The samples underwent an 8-week exercise treatment, nutrition control, and extra cinnamon supplementation. After the treatment process, the second test was conducted to determine the impact of the cinnamon extract. Furthermore, the samples entered a washout stage for 4 weeks to avoid or eliminate the previous supplementation effects. The third test was then performed to determine the condition of the athlete before placebo supplementation. It was continued with the supplementation process for another 8 weeks which ended with the fourth test to determine placebo supplementation effects.

Before the test sample prime conditions were confirmed and evidenced through a doctor's health certificate by getting enough sleep, having sufficient breakfast, and not consuming caffeinated food and drinks. The test began with anthropometric measurements, followed by body composition evaluation using the DEXA tool (GE Lunar DPX Pro, Madison, WI). Moreover, 5 mL of venous blood sample was taken to measure CK and lactate levels before heating and testing. Subsequently, the samples warmed up and performed Clean and Jerk, Snatch, and 1RM and conducted lactate, glucose, CK, and C-RP test levels. The training method during the supplementation process was adopted from previous study (Hornsby et al., 2017).

Clean and Jerk

The sample performed 3 clean and jerk movements according to match rules. The first trial was performed 2-3 minutes of rest, while the second had increased load and the same resting duration. Lastly, samples were tested with the maximum force according to their ability.

Snatch

Similarly, the snatch test is part of the match simulation to determine weightlifter performance. Therefore, it was conducted 3 times by prioritizing classes from one generation to the next, which continued to increase with 2-3 minutes rest in between.

Blood analysis

In this study, we used Cobas Mira S, USA with the kinetic method, in accordance with the rules of the International Federation of Clinical Chemistry and the German Society for Clinical Chemistry, for the determination of creatine kinase activity. For the analysis, we mixed reagent (A) creatine kinase liquid, vol.=40/80 ml (consisting of Good's buffer 125 mmol/l, magnesium acetate 12 mmol/l, EDTA 2 mmol/l, D-glucose 25

mmol/l, N-accetyl-L-cysteine 25 mmol/l, NADP 2.5 mmol/l, and HK-hexokinase 6500 U/l), with reagent (B) creatine kinase liquid, vol.=10/20 ml (consisting of ADP 15 mmol/l, AMP 25 mmol/l, di-adenosine 5-phosphate 103 µmol/l, G-6-PDH 8800 U/l, and creatine phosphate 250 mmol/l) with =340 nm at the temperature of 37°C. All protocol about blood analysist measurement was similarity and identically by previous study who conducted (Junaidi et al., 2020).

Statistical analysis

The statistical analysis tests were performed with the SPSS software, V.21.0., while normal sample distribution was checked using the Shapiro-Wilk test. A 2x2 (group: Cinnamon Group and Placebo Group) (time: pre-, post-) repeated measures analysis of variance (ANOVA) was calculated for each parameter. The independent t-test was used to reveal the differences between pre-and post-supplementation results. Also, the 95% confidence interval and percentage changes were calculated, and the statistical significance was accepted at $p<0.05$.

Results

Table 1 describes the anthropometry and age of all samples involved in the study.

Table 1. Data Anthropometry

Variables	CG group
Age (years)	22.87±3.25
Weight (kg)	76.12±18.40
Height (cm)	160.56±4.79
BMI (kg/m^2)	29.32±5.71

Table 2 contains the differences in the effect of Cinnamon and Placebo on participants' performance.

Table 2. The Influence of Cinnamon on the Performance of All Participants

Variable	Cinnamon		Placebo		p-value
	Pre-Intervention	Post-intervention	Pre-Intervention	Post-intervention	
Clean and Jerk	152.63±26.69	152.88±26.97	152.25±26.42	152.75±26.34	0.789
Snatch	118.88±26.5	118.13±26.13	119.13±26.15	118.38±26.36	0.778

Table 3 contains changes in the physiological biomarkers in all participants when taking Cinnamon and Placebo.

Table 3. Cinnamon Effects on Physiological Biomarkers in All Participants

Variable	Cinnamon				Placebo				Group	Time	Group X Time
	Pre-Intervention	Post-Intervention	Δ%	P	Pre-Intervention	Post-Intervention	Δ%	P			
pre-test CK	168.62±15.68	169.37±10.19	0.44%	0.911	161.25±8.01	163.62±10.41	1.47%	0.617	0.702	0.116	0.842
post-test CK	300.37±16.50	225.50±23.11	-24.93%	0.001*	311.50±44.28	304.87±34.16	-2.13%	0.743	0.001	0.001*	0.005*
pre-test CRP	1.37±1.03	1.41±1.05	2.92%	0.944	1.33±1.19	2.37±0.77	15.04%	0.743	0.763	0.911	0.836
post-test CRP	2.52±1.15	2.82±0.56	4.37%	0.827	1.5±1.1	3.85±0.9	-1.90%	0.919	0.905	0.128	0.005*
pre-test GLU	84.25±16.73	85.75±16.03	1.78%	0.857	82.87±13.08	80.25±8.61	-3.16%	0.634	0.910	0.493	0.680
post-test GLU	92.25±11.80	98.62±13.93	6.91%	0.340	94.50±9.62	84.75±7.77	-10.32%	0.043*	0.669	0.147	0.048*
pre-test LACT	1.72±0.63	1.56±0.55	-9.30%	0.594	1.76±0.50	1.66±0.29	-5.68%	0.635	0.475	0.707	0.864
post-test LACT	9.92±0.92	8.78±0.83	-11.49%	0.021*	8.85±1.04	9.38±0.69	5.99%	0.246	0.345	0.453	0.012*

Note. CK: Creatine kinase; GLU: Glucose-Blood glucose; CRP: C-reactive protein; LACT: Lactate-Blood lactate.
*Significant differences between Cinnamon consumption and Placebo consumption

Physiological Biomarkers

There were significant changes for all physiological biomarkers after the performance tests. CK and CRP showed significant ($p<0.005$) changes in the cinnamon group compared to placebo. There were noticeable increases and differences in glucose and lactate between the two types of supplementation which were $p<0.048$, $p<0.012$ respectively. However, there were no significant effects on physiological biomarkers before the performance test.

Performance

There were slight improvements in both clean and jerk and snatch measurements. Specifically, ANOVA showed no change in Clean and Jerk ($p<0.789$), as well as snatch ($p<0.778$).

Discussion

This study assessed on how to process 500 mg of cinnamon extract supplementation per day to improve performance and alleviate muscle soreness and damage in weightlifters. According to the hypothesis, there was a noticeable performance increase in groups given cinnamon extract on these 3 indicators. It is critical to note that performance, muscle soreness, and damage are important elements for weightlifters.

Based on the results, there was a significant difference in CK after the performance test between before and after the supplementation process compared to the placebo group. Our results, in line with previous studies. For example, study who conducted by Junaidi et al. (2020), that explained cinnamon extract increases insulin activity, preventing an increase in CK (Anderson, 2008; Islam, Yorgason, & Hazell, 2016; Fayaz, Damirchi, Zebardast, & Babaei, 2019; Junadi et al., 2020). In CRP, there are significant changes that are similar to (Fedewa, Hathaway, & Ward-Ritacco, 2017). Contrastingly, other studies using different dosage content of only 300 mg per day showed different results (Davari et al., 2020). Cinnamon stimulation, increase in insulin activity, carbohydrate metabolism, and the yield on CRP while decreasing CK levels (Khan, Safdar, Ali Khan, Khattak, & Anderson, 2003; Anderson, 2008; Vallverdu-Queralt, 2013; Anderson et al., 2015; Chen et al., 2020). The glucose test data showed significant differences between cinnamon extract and placebo groups. Cinnamaldehyde content helps stimulate an increase in glycogen and glucose. Moreover, cinnamon stimulates glucose uptake, glycogen synthesis, and active glycogen synthase in 3T3-L1 adipocytes (Jarvill-Taylor, Anderson, & Graves, 2001; Bernardo et al., 2015).

The results obtained for CK, CRP, and Glucose showed similar results with previous studies. We assume that the increase in quality that occurs in CK and CRP as an indicator of an athlete's recovery is caused by an increase in glucose and insulin activity which increases the impact of consuming cinnamon extract. On the other hand, the glucose improvement is assumed to be caused by the presence of the glucose transporter, other studies suggest that cinnamon has been shown to increase in vitro glucose uptake and glycogen synthesis and increase insulin receptor phosphorylation (Khan et al., 2003; Couturier et al., 2010). Additionally, previous studies stated that this cinnamon extract tends to help trigger the insulin cascade system (Jarvill-Taylor et al., 2001; Shen et al., 2012). Since insulin also plays a key role in lipid metabolism, we postulate that cinnamon consumption will increase blood glucose and lipids in vivo.

Clean & jerk, and snatch as a indicator of performance showed no improvements, although this finding was not in line with previous studies (Islam et al., 2016). According to the research and based on field observations, it is due to the 8 years of athlete's dependence on creatine content in this supplement. Consumption of energy supplements such as creatine content that is used excessively will have an impact on psychological effects (Hagger & Montasem, 2009; Pasiakos et al., 2017). Although this study was conducted in a double-blind manner, suggestions decreased subject self-confidence, and discomfort isolating them from the supplement. According to the results, it was concluded that different types of sport characteristics can affect the result of increasing or decreasing performance in the subject. Moreover, the level of play (amateur and professional) makes a difference to the final result.

The absence of a significant impact on these performance indicators is assumed to be due to the athletes' reliance on other supplements containing content prior to joining this study. Moreover, the habits of the samples in consuming supplements containing creatine have been carried out for more than five years. On the other hand, it creates an impact on one's energy, passion. This is in line with the testimony of samples who felt weakness and less enthusiastic after 3 days of not consuming the usual supplements (creatine). On the other hand, Physical performance during exercise, creating a brief reaction to high-intensity muscle activity (Allen, 2012). Furthermore, creatine has other positive effects, such as reducing stress and improving mood (McMorris et al 2006).

Our study has a limitation. First, we realize that, the sample size still needs to be increased in future studies, thereby reducing the risk of bias in the final results. The second increase in the number of measurement variables such as: LDH, or other psychological measurement variables should be applied in future studies, to strengthen the findings in this study. These results suggest that cinnamon is suitable for accelerated long-term and not temporary recovery. This is due to its significant impact on physiological biomarkers', 24 hours after the test. Moreover, cinnamon positively affects the acceleration of recovery in muscle damage and soreness. However, there are no performance effects determined due to subjects' creatine consuming habits. Therefore, this research can be developed by combining psychological factors with cinnamon and creatine for further studies.

Conclusion

Supplementation with 500 mg of cinnamon extract per day for 8 consecutive weeks improves muscle damage shown by an increase in CK. Also, there was an improvement in muscle soreness, evident through changes in CRP. However, the cinnamon extract does not have significant impacts on athlete performance when compared to the placebo group.

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Conflicts of Interest

The authors declare no conflict of interest.

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