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by Novita Sari Harahap

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The Effect of Red Dragon Fruit Juice Towards Cholesterol Level and Maximum Aerobic Capacity (VO₂max) on Sport Science Students Treated with Heavy Physical Exercise

N S Harahap^{1*}, A Sunarno², N Simatupang¹ and Suprayitno²

¹Department of Sports Sciences, Faculty of Sports Sciences, Universitas Negeri Medan, 20221Medan, North Sumatera, Indonesia

²Department of Physical Education and Health Recreation, Faculty of Sports Sciences, Universitas Negeri Medan, 20221Medan, North Sumatera, Indonesia

novitahrp74@gmail.com

Abstract. Heavy physical exercise causes increased production of free radicals. The accumulation of oxidative stress can reduce cardiorespiratory endurance. VO₂max plays a role as an indicator of the circumstances of cardiorespiratory. An increase in cholesterol levels is a risk factor for coronary heart disease. As a result, there is a decrease in fitness marked by a decrease in the value of VO₂max. The purpose of this study was to determine whether the antioxidant supplement given during heavy physical exercise had a beneficial effect on decrease cholesterol and the increase of VO₂max levels. The subjects were 30 students, male sex, 20-22 years old, divided into 3 groups randomly, each 10 people, group 1: subjects not given heavy physical exercise and only given a placebo (control); group 2: subjects given heavy physical exercise and placebo (HPE-RDF); group 3: subjects given heavy physical exercise and red dragon fruit juice (HPE+RDF). Measurement of cholesterol and VO₂max levels in the pre-test and post-test. The results showed that there was an increase in VO₂max and a decrease in cholesterol ($p < 0.05$) in the HPE + RDF group compared to the HPE-RDF group. The Heavy exercise group given red dragon fruit juice can increase VO₂max and reduce cholesterol levels.

1. Introduction

Physical exercise plays an active role to enhance achievement and fitness and also improves health status. Moreover, a regular and well-programmed physical exercise by increasing the training load could lead to cardiovascular disease prevention. To increase endurance and prevent the risk of cardiovascular disease, the physical exercise performed is of low to moderate intensity to be a modulator of blood vessels management and non-pharmacological circulation [1].

On the contrary, physical exercise with heavy intensity can increase the production of various types of free radicals. Free radicals formed in the body will be neutralized by the antioxidant defense systems of enzymes such as catalase (CAT), superoxide dismutase (SOD), glutathione peroxidase (GPx) and several other many non-enzyme antioxidants including vitamins A, C, glutathione, ubiquinone and flavonoids [2]. When free radical production exceeds endogenous antioxidants, it can trigger oxidative stress [3]. The accumulation of oxidative stress can damage the activation of stress-



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sensitive signaling pathways such as cardiovascular disease, insulin resistance and metabolic syndrome [4].

Cardiorespiratory endurance is the ability of heart, lungs and blood vessels to take oxygen to the maximum level and distribute it throughout the body, especially active tissue so that it can be used for the body's metabolic process called $VO_2\text{max}$ [5]. $VO_2\text{max}$ acts as an indicator of cardiorespiratory state and describes the value of maximum oxygen transport from muscles to mitochondria to produce energy. Cardiorespiratory endurance also found to be good for someone in terms of providing high energy capacity in daily activities to reduce the risk of cardiovascular disease [6]. The amount of body fat, such as excessive cholesterol, will inhibit heart function when the exercise is carried out. This happens because the muscles that are actively working, fail to perform oxygen extraction due to the disproportionate deposition of fat tissue. Excessive cholesterol is excreted from the liver into the bile as bile salt [7]. Large amounts of bile salts are absorbed into the portal circulation and return to the liver as part of the enterohepatic circulation [8]. An increase in total cholesterol levels is a risk factor for coronary heart disease. As a result, there is a decrease in fitness marked by a decrease in $VO_2\text{max}$ value.

Based on the description above, it is known that the body needs exogenous antioxidants to neutralize and prevent the chain reaction of free radicals formed due to strenuous physical exercise. Antioxidants that came from the outside through food can help the body fight excess radicals. One natural source that is widely known to possess an antioxidant potential is the red dragon fruit (*Hylocereus polyrhizus*). Red Dragon Fruit (*Hylocereus polyrhizus*) is a unique fruit and included in the cactus group with red flesh. Furthermore, red dragon fruit is currently very popular in Indonesia and has been widely consumed by the public for medicinal purpose to increase endurance and as a blood booster drug. Dragon fruit contains flavonoid compounds and polyphenols, where these compounds have antioxidant activity to bind free radicals in biological systems [9].

This study aimed was to investigate whether the antioxidant supplements given during exercise, especially strenuous physical exercise, contributed beneficial or unfavorable effects on decreasing cholesterol levels and increasing $VO_2\text{max}$.

2. Material and Methods

2.1 Location and total time duration of research

This research was performed at the Physical Laboratory, Department of Sports Science, Faculty of Sport Sciences, Universitas Negeri Medan, and Medan Regional Health Laboratory, North Sumatra, Indonesia. Moreover, this research was completed in 5 months, starting from February to June 2019.

2.2 Subjects

The research subjects were 30 students of the Sports Science study program, Universitas Negeri Medan, Indonesia. The subjects are male sex, the age range of 20-22 years, physically healthy and no smoker. The subjects did not consume supplements and antioxidants for 72 hours before the test and during the research. They not doing other physical exercises for 72 hours before the test, volunteering to participate in this study, giving written consent and getting an explanation of the research objectives and procedures.

2.3 Study design

This study is a quasi-experimental study method with the design of a randomized control group pretest posttest group design was performed. Physiological characteristics were measured which consisted of body weight, height, Body Mass Index (BMI), resting pulse, a maximum pulse, and blood pressure. Initial tests were performed to check cholesterol and $VO_2\text{max}$ levels. The research subjects were divided into 3 groups randomly, with 10 people each. Group 1: subjects that were not given with heavy physical exercise and only given with a placebo (control); group 2: subjects that were given with heavy physical exercise and placebo (HPE-RDF); group 3: subjects that were given with heavy physical exercise and red dragon fruit juice (HPE + RDF). Then, cholesterol and $VO_2\text{max}$ levels in the pre-test and post-test investigation were conducted at the Universitas Negeri Medan stadium. Controlling was performed by evaluating subjects diets, supplements and vitamin consumption that

contain antioxidants, enough rest, should not be absent during training to maintain homogeneity during the study and the changes that occur are the effects of treatment

2.4 Ethical approval

This study was given ethical approval from the Ethics Committee on the Implementation of Health Research in the Faculty of Medicine, Universitas Sumatera Utara (No. 169 / TGL / KEPK FK USU-RSUP HAM / 2019).

2.5 Heavy physical exercise procedures

Physical exercise was conducted by using a treadmill, with a slope of 0°, speed level of 10-12, exercise level of 80-85% from the maximum pulse, 30 minutes, frequency of 3 times a week, and conducted for 4 weeks.

2.6 Red dragon fruit dosage

Red dragon fruit juice with a dose of 2.8 g/Kg BW was mashed with blender and added with 70 mL of water. This juice was given to subjects every day for 4 weeks. Placebo was in the form of low-calorie syrup with coco pandan flavor and given every day for 4 weeks..

2.7 VO₂max measurement procedures

VO₂max examination is performed by using the multistage 20-m shuttle run fitness test (20mMSFT), in the form of an alternating run test on a 20 m flat track following standardized audio cues. The results obtained were in the form of level and feedback records that have been taken by each subject. The results of the level and feedback were then converted to VO₂max values using a standardized VO₂max conversion table. The multi-stage 20-m shuttle run fitness test (20mMSFT) is a valid and effective test for measuring VO₂max values.

2.8 Cholesterol levels investigation

Cholesterol levels were taken from venous blood, conducted by a health analyst and examined at the Regional Health Laboratory of North Sumatra, Indonesia.

2.9 Statistical analysis

Statistical analysis was carried out via SPSS software version 20. ANOVA statistical test (if the data is normally distributed) and the Kruskal Wallis test (if the data is not normally distributed) were performed. If the Anova test result is significant ($p < 0.05$), then it is continued with the smallest significant difference test, Bonferroni Test ($p < 0.05$), to find out the best effect of exercise towards the response variable.

3. Result

The Normality test of cholesterol levels and VO₂max have a normal distribution and same variance data, thus data analysis was done on The ANOVA test. The results of the study show that the average of cholesterol levels and VO₂max students which treat with heavy physical exercise and given Red dragon fruit can be seen in Table 1. The average cholesterol levels there was a decrease after treatment in the HPE-RDF group (151.60 ± 3.69 vs 146.20 ± 3.88 mg/dl) and HPE+RDF group (151.40 ± 3.66 vs 138.60 ± 3.86 mg/dl).

The average VO₂max there was an increase after treatment in the HPE-RDF group (45.16 ± 1.37 vs 146.20 ± 3.88 vs 45.34 ± 0.53 ml/kg/min) and HPE+RDF group (151.40 ± 3.66 vs 138.60 ± 3.86 ml/kg/min).

In the analysis with the Anova test, the data indicates that there is a meaningful difference in the decrease ($p < 0.05$) on average cholesterol and an increase in VO₂max differences in the control group of the HPE-RDF group and the HPE+RDF Group.

Figure 1, shows the average data that the cholesterol levels in HPE+RDF Group is lower than the HPE-RDF group and control group (138.60 ± 3.86 vs 146.20 ± 3.88 vs 150.90 ± 4.07). Figure 2, shows

that the VO_2 max in the HPE+RDF group is higher than VO_2 max than the HPE-RDF group and control group (47.83 ± 0.63 vs 45.34 ± 0.53 vs 45.11 ± 0.61).

Tabel 1. Average value of Cholesterol levels dan Maximum Aerobic Capacity (VO_2 max) in the student after Heavy Physical Exercise

Variables	Mean \pm SD			p-value
	Control	HPE-RDF	HPE+RDF	
Cholesterol (mg/dl)				
Pre-exercise	150.30 \pm 2.71	151.60 \pm 3.69	151.40 \pm 3.66	0.656
Post-exercise	150.90 \pm 4.07	146.20 \pm 3.88	138.60 \pm 3.86	0.000*
VO_2max (ml/kg/min)				
Pre-exercise	45.18 \pm 0.79	45.16 \pm 1.37	45.15 \pm 1.41	0.998
Post-exercise	45.11 \pm 0.61	45.34 \pm 0.53	47.83 \pm 0.63	0.000*

note: HPE= heavy physical exercise, HPE+RDF= heavy physical exercise and red dragon fruit,
 *Significance (p = 0.05), SD: Standard deviation

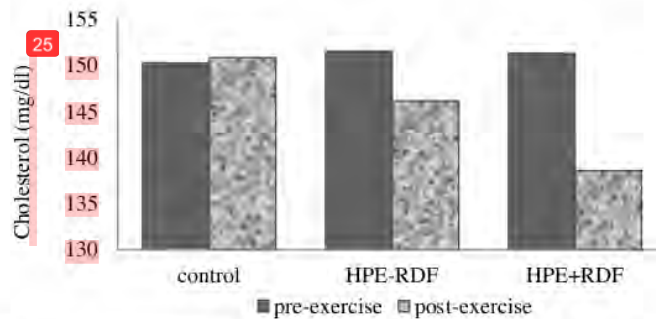


Figure 1. Cholesterol content in the student after Heavy Physical Exercise

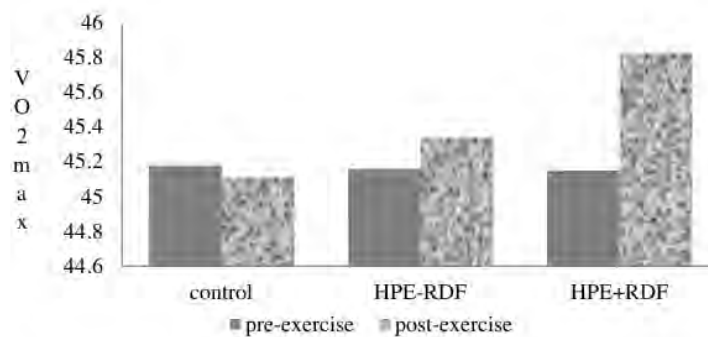


Figure 2. Maximum Aerobic Capacity (VO_2 max) content in the student after Heavy Physical Exercise

4. Discussion

High-intensity exercise, in the same period time, will require far more energy compared to mild or moderate-intensity exercise [10]. As a result, the main energy source for muscle contraction in high-intensity aerobic exercise is carbohydrate. Conversely, in aerobic exercise with mild intensity, the cardiovascular system is still able to meet the needs of contracting muscles, so fat is needed as the main energy source for muscle contraction. Therefore, the energy source in moderate-intensity aerobic exercise is carbohydrate and fat in a balanced way [11].

The research was found that mild-moderate aerobic exercise can reduce body fat percentage by 20.46%, while high-intensity aerobic exercise can only reduce body fat percentage by 4.63% after being treated for 6 weeks. The research was stated that acute resistance training could lead to changes in the lipid profiles that depend on specific intensities. Low and moderate-intensity physical exercise has a beneficial effect on reducing cholesterol levels compared to high-intensity physical exercise [12]. On the other hand, red dragon fruit has several nutritional contents including vitamin A, vitamin C, vitamin E, niacin, polyphenols, anthocyanin, and flavonoids.

The results of the research indicated that natural antioxidants are more effective than vitamin C and E supplementation. Furthermore, the result of the research discovered that red dragon fruit has a higher antioxidant capacity potential than white dragon fruit due to the presence of red pigment (anthocyanidin). Flavonoid antioxidants have been widely studied as a protection against oxidative stress [13]. Moreover, it provides protection to the body to avoid cardiovascular disease and various chronic diseases [14], improves vascular endothelial function [15] and is categorized as hypolipidemic and anti-inflammatory [16,17].

VO₂ max volume is a level of the body's activity expressed in liters per minute or milliliters/minute/kg body weight. Every cell in the human body needs oxygen to change food becomes ATP (adenosine triphosphate) which is ready for use the work of each cell that consumes the least oxygen is muscle resting state. Contracting muscle cells require a lot of ATP. As a result, the muscles used in exercise require more oxygen and produce CO₂ [18].

Heavy physical exercise, large free radicals are produced and tend to cause oxidative stress. To prevent oxidative damage, it suggests consuming antioxidants. Good Exercise for increasing VO₂ max is a type of cardio or aerobic exercise, an exercise that stimulates the heartbeat, lung and muscular system [19].

5. Conclusion

Red Dragon Fruit has the potential as an antioxidant that can decrease cholesterol levels and increase the maximum capacity of oxygen (VO₂max) after Heavy Physical Exercise. The data indicates that there is a meaningful difference in the decrease (p<0.05) on average cholesterol and the increase in VO₂max differences in the control group the HPE-RDF group and the HPE+RDF Group.

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