Potential of The Red Dragon Fruit *(Hylocereus polyrhizus)* as Antioxidant to Increase Catalase Giving High-Intensity Physical Activity

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Abstract. High intensity physical activity tends to make free radicals more active and cause a decrease in endogenous antioxidants such as catalase. Oxidative stress can be prevented by consuming food like red dragon fruit. The purpose of this study was to determine the potential of red dragon fruit as an antioxidant that can neutralize free radicals cause high-intensity physical activity. The subjects consisted of 20 male students and were divided into 2 group P1 (control); given high-intensity physical activity and placebo, group P2 (treatment) given high-intensity physical activity and red dragon fruit juice. The results showed there was a significant effect of red dragon fruit on to increase of antioxidant catalase in the group P2 compared to the group P1. The conclusion of this study states that red dragon fruit has the potential as an exogenous antioxidant that can neutralize free radicals triggered by high-intensity physical activity.

Keywords: Physical activity, Free radicals, catalase, red dragon fruit

1 Introduction

Owing to increased body metabolism, oxygen consumption in muscle fibers can increase by up to 20 times during high-intensity physical activity[1]. Some organs such as the liver, kidneys , and other organs will experience hypoxia and ischemia during high-intensity physical activity because energy is needed to convert ATP into ADP (Adenosine Diphosphate) and AMP (Adenosine Monophosphate). If the oxygen supply is inadequate, AMP is converted to hypoxanthine. After physical exercise, the blood flow will return to normal through the mechanism of reperfusion, with the enzyme xanthine oxidase converting hypoxanthine to xanthine and uric acid. This process creates free radicals that have lipid peroxidation reactions that damage cell membranes[2].

The body will typically generate its antioxidants in a biological system, such as superoxide dismutase, catalase , and glutathione peroxidase (endogens). Those are

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enzymatic antioxidants can neutralize free radicals that are formed in the body [3]. When free radical production exceeds cellular defense antioxidants, oxidative stress can occur [4,5].

Research showed that high-intensity physical activity might cause decreased levels of enzymatic antioxidants such as catalase (CAT), superoxide dismutase (SOD) and glutathione peroxidase (GPx) [6]. Research by Bulduk et al. (2011) reported that volleyball athletes who often run shows free radicals' formation which is characterized by decreased levels of antioxidant catalase and GPx [7].

Decreasing antioxidant levels due to high-intensity physical activity can be prevented by optimizing nutrition especially by increasing the antioxidant content [8,9]. Some research report that consuming natural ingredients is known to increase levels of antioxidant catalase (CAT) and glutathione peroxidase (GPx) [10,11].

One natural food source that contains antioxidants is Red Dragon Fruit (RDF), which is a type of cactus that has been widely discussed in the community, especially in Indonesia due to its beneficial properties for human health. RDF contains natural antioxidant compounds in the form of polyphenols and flavonoids, its function can inhibit and neutralize oxidation reactions involving free radicals, both exogenous and endogenous [12,13]. Polyphenol secondary metabolite compounds such as flavonoids can provide antioxidant effects by preventing the generation of ROS, directly capturing ROS, or indirectly increasing enzymes [14].

The purpose of this study was to determine RDF's potential and its ability to increase the level of antioxidant catalase in students with high-intensity physical activity.

2 Methods

2.1 Ethical recognition

This research was given ethical approval by Universitas Sumatera Utara (No. 59 / KEP / FK USU/2020) of the Ethics Committee on the Application of medical research in the Faculty of Medicine.

2.2 Study design

This work was carried out using an experimental quasy approach with the pretest and post-test group design. This research was carried out at the Faculty of Sport Sciences' Physical Laboratory, Universitas Negeri Medan, and the Medical Faculty's Laboratory, Universitas Sumatera Utara.

2.3 Subjects

The research subjects consisted of 20 people, male, students of the Faculty of Sport Sciences, Universitas Negeri Medan who were not trained as athletes and had met the following criteria: male, no physical exercise before the research, non-athlete, non-smoker and no consumption of supplements and antioxidants 2 weeks before and during the study's inclusion and exclusion. The study subjects were divided randomly into 2 groups, each group consisted of 10 students, namely group P1 (control): given a treadmill an intensity of 80-85% of maximum heart rate and placebo, group P2 (treatment) given treadmill an intensity of 80-85% of maximum heart rate and RDF juice. Before the research begins, an explanation is given to prospective research subjects regarding the aims and objectives of the study. Afterward, the samples who are willing to take part in the study signed an informed consent or consent form. Furthermore, in the laboratory of the Faculty of Medicine, Universitas Sumatera Utara, the catalase levels for the pre- and post-test were examined.

2.4 Physical activity procedures

Physical activity is carried out by exercising on a treadmill with an intensity of 80-85% of maximum heart rate, speed level of 10-12, duration 30 minutes, 3 times a week for 21 days. Red dragon fruit juice was given daily at a dosage of 2.8 g / kg BW for 21 days, blended with 70 ml water. Supply of red dragon fruit juice with a dosage of 2.8 g / kgBB smoothed with a blender and then added 70 ml of water for 21 days per day [15]. Research by Khotimah (2018) using the same dose and given for 14 days, the difference is the time of administration of red dragon fruit juice in this study is longer that is for 21 days.

2.5 Catalase measured

Catalase levels was measured used serum by spectrophotometric method ELISA (*Enzyme-Linked Immunosorbent Assay*, reagensia Human Catalase (CAT) ELISA Kit, Catalog Number MBS703074.

2.6 Statistical analysis

Data were analyzed using paired t-test with $\alpha = 0.05$, to test the effect of each variable and Independent sample t-test with $\alpha = 0.05$, to analyze whether there was an effect of red dragon fruit juice consumption on catalytic antioxidant levels. The data obtained were then processed with statistical procedures using SPSS.

3 Results and Discussions

The results of the study as in table 1, show that in the group P1 there was a significant decrease in average catalase levels (124.61 ± 48.45 vs 88.33 ± 54.64; P = 0.037; $p<0.05$). In the group P2, there was a significant increase in average catalase levels (113.74 ± 38.30 vs 183.80 ± 71.01; p = 0.001; $p<0.05$).

Table 1. Average catalase levels on group

Group	*Pre test*		*Post test*		Nilai p
	Mean	**sd**	**Mean**	**sd**	
P1	124.61 (pg/ml)	48.45	88.33 (pg/ml)	54.64	0.037*
P2	113.74 (pg/ml)	38.30	183.80 (pg/ml)	71.01	0,001*

Note : P1= control group; P2= treatment group; sd= standar deviation; *=significant= P<0.05

Further analysis showed that there was a significant increase in catalase levels in the group P1 compared to the group P2 (183.80 ± 71.01 vs 88.33 ± 54.64; p=0.003; p<0.05).

Table 2. Different catalase level on group

Group	Mean	sd	pValue
P1	88.33 (pg/ml)	54.64	0.003*
P2	183.80 (pg/ml)	71.01	

Note : P1= control group; P2= treatment group; sd= standar deviation; *=significant=p<0.05

Based on table 2, it shows that there is an increase in antioxidant levels in the high-intensity physical activity group with red dragon fruit consumption compared to the high-intensity physical activity group that does not consume red dragon fruit (183.80 ± 71.01 vs 88.33 ± 54.64; p= 0.003; p<0.05). Therefore, It can be inferred that red dragon fruit has the capacity as an exogenous antioxidant capable of growing antioxidant catalase rates in students with high physical activity.

A decrease in catalase levels was found in the high-intensity physical activity category which did not drink red dragon fruit juice. The decrease in catalase levels occurred due to reactive free radicals produced during physical activity of high intensity. Oxygen intake increases during high-intensity physical activity due to the rising energy demands of contracting muscles. This rise in oxygen consumption is causing the production of free radicals and Reactive Oxygen Species (ROS) to increase[16]. Decreased rates of catalase in the control group was consistent with research performed by Castro et al. (2009) who reported that training with an intensity of 80 per cent of maximum heart rate decreased levels of catalase compared to training with an intensity of 60 per cent and & 70 per cent of maximum heart rate. This occurs because antioxidants function at an intensity of 80 percent of the normal heart rate during exercise to compensate for the development of free radicals [17].

Free radicals are atoms or molecules with unpaired electrons in their outermost orbits. These unpaired electrons cause the compound to be extremely reactive to look for a pair, by attacking or binding to the electrons of other molecules that are around it, hence new free radicals are formed [18]. Continuously increasing free radicals cause hydrogen peroxide to increase, this condition disrupts endogenous antioxidant activity. It could further decrease the level of endogenous antioxidants and cause an imbalance between oxidants and endogenous antioxidants. A new balance can occur if the body gets additional antioxidants externally [19].

Besides that, this study also found that increasing catalase levels in subject with high-intensity physical activity who consumed natural antioxidants such as red dragon fruit cause red dragon fruit contains natural antioxidant compounds in the form of polyphenols and flavonoids. The increase in catalase levels happened due to the antioxidant's ability to capture and neutralize free radicals so that further reactions that cause oxidative stress can be stopped and cell damage can be avoided. Antioxidant termination reactions usually occur by capturing hydroxyl radicals at the peroxidation stage of fat, protein, or other molecules on normal cell membranes to avoid cell damage. Neutralization is done by injecting one electron to create a more stable compound, or to induce a termination reaction, and to end radical reactions or to stop oxidative stress in the cell [5].

Oxidative stress prevailed due to insufficient oxygen and nutrients, causing ischemic processes and damage to the microvascular. This condition is called Damage of reperfusion. It can also cause damage to the tissue due to the excessive development of free radicals [20]. Red dragon fruit consumption as an exogenous antioxidant before high-intensity physical activity in treatment group was proven to prevent an increase in free radicals. This is because free radicals which cannot be neutralized by endogenous antioxidants will be neutralized by various antioxidants contained in red dragon fruit. Antioxidants contained in red dragon fruit stabilize free radicals by completing the lack of electrons possessed by free radicals and inhibit the chain reaction of the formation of free radicals that can cause oxidative stress [21]. As a result, the balance between oxidants and antioxidants can be maintained, in other words, oxidative stress can be avoided.

Catalase is an enzyme composed of more than 500 amino acids with a porphyrin group. This enzyme catalyzes the reaction of the compound hydrogen peroxide reduction (H_2O_2) to oxygen (O_2) and water (H_2O). The catalase activity is optimal at pH 7 and can increase with increasing H_2O_2 accumulation. High concentrations of catalase are found in the liver, blood, kidneys, brain, lungs, adipose tissue, and adrenal glands [22].

4 Conclusion

The conclusion of this study states that RDF has the potential as an exogenous antioxidant with the ability to neutralize free radicals that are triggered by high-intensity physical activity marked by increased levels of catalase.

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