The Difference of Superoxide Dismutase (SOD) Level after Consuming Red Guava Juice (*Psidium Guajava* L. Red Cultivar) During Aerobic Exercise for the Beginner

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Abstract

Aerobic exercise for the beginner causes overly muscle contraction and the use of occasionally used muscle, so that additional unit motor recruitment is needed. Consequently, metabolism inside the body increases. If the antioxidant inside the body is not enough, oxidative stress will occur. Antioxidant is needed to prevent the occurrence of oxidative stress. The design of this research was experimental-nonrandomized pre-post test control group design. The subjects of the research were divided into 2 groups, i.e. the red guava juice and mineral water groups. Both groups performed aerobic exercise for 30 minutes every day for 27 days. Blood samples were taken for measuring superoxide dismutase (SOD) level. T-test and repeated anova test were used for data analysis. T-test and repeated anova analysis amount of SOD level showed that there was no difference between red guava juice group and mineral water group (p>0,05). There was a decrease in the amount of SOD level for the beginners during aerobic exercise, but statistically it was not significantly different between the group which consumed red guava juice and the group which consumed water.

Keywords: *aerobic exercise, the beginner, red guava juice, SOD level*

INTRODUCTION

Physical exercise can cause positive effects to the body, i.e. the body can get healthier and fitter. The effects in the cellular level are increase of the number of lipid oxidation, enzyme muscle glycogen, mitochondria, and mioglobin. Anaerobic exercise increases fosfagen, ATP-PC, and glycolisis enzyme. The negative impact of physical exercise is damage of muscle or muscle injury. Overly done physical exercise, which is not suited to the one's physical capacity, and done by untrained people may result in muscle and joint pain. This symptom is called delayed onset muscle soreness (DOMS). The muscle damage on physical exercise is caused by mechanical trauma when muscle, followed by oxidative stress, is contracted (Foss, 1998).

Aerobic training for the beginner may cause over muscle contraction, the use of unused muscle, so it needs additional unit motor recruitment. Bone muscle contraction is mechanical, chemical, and electrical incident, consisted of six stages called cross bridge cycle. For untrained people, power stroke, sliding filament, and disconnecting in cross bridge cycle are mechanical trauma, which may cause muscle injury (Len, 2002).

The area suffering from muscle injury will extract chemo attractant which attract neutrophils into the muscle injury area, followed by the formation of reactive oxygen species (ROS) used as body protection. In a normal situation, the formation of ROS will be balanced by the

formation of endogenous antioxidant such as superoxide dismutase (SOD), glutathione peroxides (GPx), and catalase. Oxidative stress will occur when the formation of antioxidant is smaller than that of free radical (Halliwel and Gutteridge, 1999; Shojaei *et al*., 2010)

Body is a complex antioxidant system to protect from free radical particles. Endogenous antioxidants are superoxide dismutase (SOD), glutathione peroxydes (GPx), catalysis, and endogen antioxidant who amount depends on the food intake. Although body can naturally overcome the increase of free radicals, but, in a certain condition, endogenous antioxidant is not enough, so body needs antioxidant from outside the body. (Harjanto, 2004).

Antioxidants can be categorized as enzyme and non-enzyme antioxidants, also chain breaker and deterrent antioxidants. The examples of enzyme antioxidants are SOD, glutathione peroxides, and catalysis, while the examples of non-enzyme antioxidant are, vitamin E, glutathione, and vitamin C (Harjanto, 2006). The prevention of reactive free radical formation can be done, for example by destroying the early substance which is in the form of peroxides or the result of oxygen metabolism by superoxide dismutase enzyme (SOD) and by destroying by using nutrition substance as exogenous antioxidant, such as, vitamin E, carotene, and vitamin C. Both antioxidants must always be inside the body (Muhilal, 1999).

Guava (*P. guajava* L) is a natural supplement, in the form of fruit, as an antioxidant source. Guava (*P. guajava* L) is a fruit which is generally consumed in Indonesia and it is found and known by people. Guava (*P. guajava* L) is a fruit which contains vitamin C particles, potassium, B-carotene, Fe, Se, Cu, Zn, lycopene, lutein, xanthine, cryptoxanthine, zeaxanthine, anthozyanidin, quercetin, lignin, and anti inflammation (Wiralis dan Purwaningsih, 2009).

The purpose of this research was to study the difference in superoxide dismutase (SOD) level between the group who consumes red guava juice and the group who does not consume it during aerobic training for the beginner.

Material and Method

The design of this research was experimental research, with non-randomized pre-post test control group design. The independent variable was red guava juice and dependent variable was the SOD level. Controlled variables were age, nutrition status, the lenght of treatment, health status, sex, food intake, and physical activity.

Each group of the research subject consisted of 8 people, with inclusion criteria: university student living in STPN Yogyakarta dormitory, men aged 17-25 years old, healthy, normal nutrition status, willing to be research subject, consume dormitory's meal, never suffered from chronic disease, do not smoke, never followed the aerobic exercise program based on FITT guidelines (frequency, intensity, time, and type) minimally in the last 6 years and non athletes. Exclusion criteria used are consuming antioxidant vitamin and not willing to be research subject.

Materials in this research were red guava (*P. guajava* L. Cultivar *Merah*), 800 g in 1200 ml mineral water, given in the form of juice, 240 ml for each subject, subject's blood with 1 mg/ml activity EDTA (etilen diamin tetra acetate) anticoagulant. The equipments used were test tube, centrifuge tube flask, measuring pipette, dining table scales, sphygmo-manometer mercury, injection syringe, cotton, alcohol, EDTA tube, digital body scale (Smic brand), microtoise (stature-meter brand), body temperature thermo-meter (Omron brand), environment tem-perature thermometer (Gea brand), juicer/ blender, Heart Rate Monitor (Omron HR-l00C brand).

The difference level of inter group SOD was analyzed using independent t-test. The difference of measurement data of each group uses repeated anova statistic analysis.

RESULT AND DISCUSSION

The subject of this research were student of Sekolah Tinggi Pertanahan Nasional (STPN) Yogyakarta who live in a dormitory. The subjects were men, divided into 2 groups, red guava juice group and mineral water group. The juice and mineral water were consumed every day at 5 a.m for 27 days, both groups get aerobic exercise treatment, which is running (jogging) every day. Before doing data analysis, Shapiro-wilk test normality test was done. Subject characteristics of both groups did not show any significant difference.

The food intake of research subject uses 24 hour food recall method. The result of 24 hour food recall was analyzed with nutrisurvey, which then compared to daily needs based on Recommended Dietary Allowance (2005) for men of 19-29 years old. The percentage of energy intake, fat, protein, vitamin C, Cu, and Mn of red guava group was in good category, which intake percentage was >100%, while carbohydrate and Zn was in mild category, and Vitamin C was in deficit category. In the mineral water group, which intake percentage was >100%, fat, protein, Cu, and Mn were in good category, energy was in mild category, carbohydrate and zinc were in low category, and vitamin C as well as vitamin E were deficit category.

The results of t-test and repeated anova for SOD level between red guava juice group and mineral water group showed that there were no differences (p>0,05).

Discussion

Nutrient content in the red guava juice is vitamin C, lycopene, flavonoids, and other important nutrients. Red guava contains lycopene, included as lipophilic antioxidant, which is able to slow down lipid peroxyls radicals and catch single oxygen which then is neutralized, so that chain reaction stops and causes less lipid peroxidation formation. Lycopene is able to stimulate the work of antioxidant enzyme, such as SOD, GPx, and catalase. SOD enzyme is functioned to prevent the hoarding of superoxides, catalase enzyme, and GPx prevent the hoarding of H_2O_2 by the way to release H_2O_2 to be H_2O or $H_2O + O_2$. The decrease of H_2O_2 means that hydroxyl radicals formation can be prevented, so that lipid peroxidation will decrease will decrease, and inflammation or tissue damage can be deterred.

Superoxde Dismutase (SOD) level in both groups increased, although there was no significant difference between both groups. This happened because of the adaptation process of antioxidant defense system towards regular physical exercise done by the subjects. Light intensity exercise can increase antioxidant activity if it is done in a long period of time (Kobe *et al*., 2002). Besides, the intake percentage of food, energy, protein, fat, carbohydrate, vitamin C, Cu, Zn, Mn were in good category. The availability of micro nutrient substances (Cu, Zn, and Mn) influences SOD activity. Cuprum mineral is important for the function of enzyme catalytic and zinc is important in structural function (Winarsi, 2007)

Table 1. Result of SOD Level Analysis (U/mL)

Result	Group		p value*	p value**	
	G-1	G-2		G-1	G-2
After LA_1	2,31±0,94	2,27±0,98	0,924	0,247	0,190
After LA_7	2,34±1,88	2,49±1,02	0,837		
After LA_{14}	3,06±0,66	3,24±1,46	0,759		

Note: * t-test analysis result **Repeated Anova analysis result

In this research, the value of antioxidant status only used one parameter, SOD. In some researches, which use more than one antioxidant parameter, i.e. SOD, GPx, and catalase, antioxidant response towards oxidative stress sometimes is only seen in some enzymes, i.e. SOD and GPx, but not in catalase (Margaritis *et al*., 2003)

Intensity of aerobic exercise used in this research was light, considering that the subjects of the research were beginners, and mild intensity exercise is useful to increase cardiovascular capacity as well as to minimize injury, but enough to find out oxidative stress caused by the exercise. Mild intensity exercise can increase production of free radicals exceeding antioxidant defense capacity, so that oxidative stress occurs (Alessio, 1993).

Aerobic exercise, done regularly in a long term, has positive effect on oxidative stress. This happens because aerobics exercise causes mild oxidative stress, by that the formed free radicals can be responded by modulating cellular response, which triggers antioxidant enzyme gene expression, so that antioxidant enzyme up regulation happens (Ambardini, 2005).

Response of antioxidant defense system towards aerobics exercise depends on many factors. These factors are, exercise duration, exercise intensity, previous exercise exposure, and age. Result variability is caused by the difference of the use of exercise models, the time of sample taking, the status of subjects' exercise, and environment, like height factor (Selman *et al*., 2002)

Antioxidant response is also influenced by exercise frequency, cycling effect in 6 weeks, three times a week, towards antioxidant enzyme activity a skeletal muscle, significant change is not found. After increasing the exercise to become two times a day for one week, it turns out that significant increase on antioxidant enzyme activity is gained (Sjodin *et al*., 1996)

Individual status, trained or untrained, has a role in the formation of free radicals. The untrained individual has undergone adaptation process where antioxidant enzyme increase and oxidative ability occurs, so that the use of oxygen for energy need is more efficient (Sutarina dan Tambunan, 2004). For trained and untrained men and women who do running exercise, the result shows an increase on mitochondria oxidative ability and antioxidant enzyme on the trained people (Stupka *et al*., 2001)

In this research, red guava juice was given. It is one of vitamin C sources, while vitamin C is known as one of main antioxidants. Effect on consuming vitamin C for active people who do many exercises are widely researched. The result of research about vitamin C effect towards oxidative stress because of exercise is still varied. The consuming of vitamin C decreases oxidative stress because of exercise (Alessio *et al.,* 1997)

CONCLUSION AND SUGGESTION

It can be concluded from the research result that there was no difference in the Superoxide Dismutase (SOD) activity for the beginner during aerobic exercise between a group consuming red guava juice a group who did not consume it.

It is better to have a research using more than one antioxidant enzyme parameters and by measuring the occurrence of free radicals during aerobic exercise to gain insight clearly about body antioxidant defense system.

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