The Effects of Red Fruit Extract Supplementation on Blood Lactate Concentration after Sub-Maximal Exercise

Pahala Tua Hutajulu and Yohanis Manfred Mandosir
Cenderawasih University, Abepura, Jayapura, Indonesia
hutajulupahala@gmail.com

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Abstract: In this study, the use of red fruit (*Pandanus conoideus Lam*) extract as an alternative natural resource of an antioxidant supplement was introduced. The purpose of this study was to compare the effects of red fruit extract supplementation on blood lactate concentration after sub-maximal exercise. The maximal exercise was applied as an exercise test in order to assess the aerobic capacity. Fourteen amateur soccer athletes from Jayapura, Indonesia, volunteered to take part in the study, where they were randomly divided into two groups: placebo and supplement. Four hours prior to the sub-maximal exercise, the subjects consumed either a placebo or 1000 mg of red fruit extract supplement. The subjects' blood lactate concentration was recorded at four hours pre and post sub-maximal exercise. The sub-maximal exercise resulted in an increase of blood lactate concentration in both the placebo (1.30 ± 0.69 to 2.73 ± 0.58 mmol/L) and supplement groups (1.01 ± 0.39 to 2.14 ± 0.36 mmol/L). Although the increase of blood lactate concentration after performed sub-maximal exercise of supplement group was lower compared to the placebo group, independent t-test calculation shows no significant effect of red fruit extract supplementation.

1 INTRODUCTION

Physical training is the foundation for an athlete to achieve the highest level of physical performance (Stone et al., 2007). The improvement of physical performance resulted from multiple adaptive reactions, which occurs primarily in the skeletal muscle fibers, nervous system, and circulatory system (Clausen, 1977). Although the physical effect of training could be very individualized, in general, there are four types of physical activities based on their effects. First, aerobic activity which may improve body composition and cardio respiratory fitness; second, muscle-strengthening activity which may improve muscular fitness such as muscular strength and endurance; third, stretching activity that can improve flexibility and last is neuromuscular activity that improves neuromuscular fitness such as balance and agility. Among these four, the aerobic activity is typically performed by a high intensity sport athlete, particularly a soccer athlete (O'Reilly and Wong, 2012).

In order to assess the aerobic capacity, there are two kinds of exercise tests, maximal and sub-maximal exercises. The maximal exercise was considered the gold standard with higher precision however was limited due to high risk of pain and fatigue since it requires a maximal level of exertion. Contrarily, sub-maximal exercise appears to have merits since it is safer and minimizes undue strain (Noonan and Dean, 2000). There are large numbers of sub-maximal testing protocols that have been proposed. Among them, the Astrand and Ryhming (1954), Margaria et al. (1965), and McArdle et al. (1972) are examples of protocols that have been well developed in very fit individuals, so they can be used to evaluate aerobic capacity of an athlete.

Previous study has been revealed that the blood lactate concentration increases early in the periods of sub-maximal exercise (Rieu et al., 1989), although it could be lower after a long term of exercise due to adaptations to training (Hurley et al., 1984). It is known that lactate is a major cause of muscle fatigue and induced tissue damage (Gladden, 2004) due to the high production of oxygen free radicals. The human body naturally has the ability to neutralize oxygen free radicals by forming endogenous antioxidants, however, the use of antioxidant supplements to quench oxygen free radicals has attracted attention in recent years (Ackerman et al., 2014). Natural ingredients, such as fruits and vegetables, have been studied and exhibit antioxidant content such as avocado, jackfruit, longan, mango and tamarind

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(Soong et al., 2004; Leonard et al., 2002) which can reduce oxygen-free radicals and lactic acid levels.

In this study, we introduced the red fruit (*Pandanusconoideus Lam*), a typical plant which grows in Papua. Current studies have shown that red fruit has rich content in phenolics, flavonoid, and carotenoid, which strongly indicated that it can be used as a natural antioxidant source (Rohman et al., 2010; Rohman et al., 2012). Therefore, we utilized the red fruit extract as an antioxidant supplementation. The purpose of this research was to study the effects of red fruit extract supplementation on blood lactate concentration after sub-maximal exercise.

2 EXPERIMENTAL METHODS

Fourteen soccer amateur athletes from Jayapura, Indonesia, who were well trained, volunteered to take part in the study after they were informed verbally and literally about the nature of the experiment. Each subject reported to the laboratory before the actual experiments and performed a practical trial of sub-maximal exercises. Their height was measured using body height tape (HKS 6.56Ft Measure Tape) while their body weight and body composition were measured using Omron HBF-214 Body Composition Monitors.

The subjects were instructed to abstain from all supplements and to rest well for 48 hours. They were randomly divided into two groups: placebo and supplement. Four hours prior to the sub-maximal exercise, each subject consumed either a placebo or 1000 mg of red fruit extract supplement. The Subjects' blood lactate concentration was also recorded in this initial condition. Subsequently, all subjects consumed enough meals and rested quietly for 4 hours. Afterwards, the blood lactate concentration pre exercise was recorded. Hereafter, each subject performed sub-maximal exercise following the Astrand-Ryhming protocols (Astrand and Ryhming, 1954), using Kettler Paso's 109 cycles ergo meter. Finally, the blood lactate concentration post exercise was recorded again soon after the exercise. The blood lactate concentration was recorded using Roche Accutrend Plus. During sub-maximal exercise the subjects' heart rate was monitored with a Polar H7 heart rate monitor.

3 RESULTS AND DISCUSSIONS

The group descriptive measurements (placebo vs. supplement) are noted in table 1. All participants were found to be in normal range in age, height, body weight, and body composition. There were no significant differences between the placebo and supplement groups with regards to the general descriptive measures taken.

Table 1: Subjects descriptive statistics.

	Placebo (n = 7)		Supplement (n = 7)	
	Mean	SD	Mean	SD
Age (yr)	21.86	2.54	22.00	2.77
Height (cm)	158.57	5.69	147.21	38.95
Weight (kg)	59.24	9.92	60.76	6.51
BMI	22.49	1.98	22.76	2.00
Fat (%)	24.74	3.25	24.96	2.82
Visceral fat	3.71	1.11	3.29	1.11

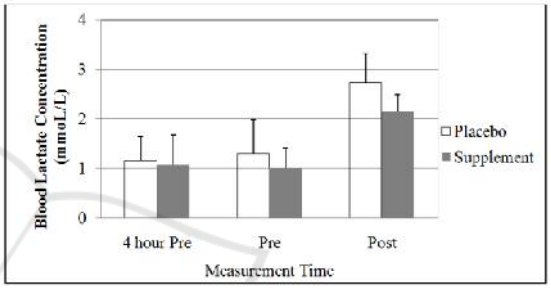

Figure 1: Blood lactate concentration of placebo and supplement groups.

Figure 1 shows blood lactate concentration of both placebo and supplement groups. The blood lactate concentration value at 4 hours pre sub-maximal exercise for both placebo and supplement groups were 1.15 ± 0.49 mmol/L and 1.07 ± 0.61 mmol/L, confirming that they had rested well before the experiment (Zhang and Ji, 2016). This condition was maintained during four hours of resting, as shown by no significant differences in blood lactate concentration values measured at pre sub-maximal exercise, with value of 1.30 ± 0.69 mmol/L and 1.01 ± 0.39 mmol/L respectively. Statistically, the paired t-test confirmed no significant difference in blood lactate concentration value measured at 4 hours prior and pre sub-maximal exercise for both groups, as noted in table 2.

Table 2: Paired t-test calculation between 4 hr rest time.

	t	t_{table}
Placebo	-0.352	2.447
Supplement	0.182	
$p < 0.05$		

The sub-maximal exercise resulted in an increase of blood lactate concentration in both the placebo (1.30 ± 0.69 to 2.73 ± 0.58 mmol/L) and supplement

group (1.01 ± 0.39 to 2.14 ± 0.36 mmol/L). Table 3 shows the paired t-test calculation between pre and post sub-maximal exercise for placebo and supplement, which confirmed that there is a significant difference in blood lactate concentration between pre and post sub-maximal exercise.

Table 3: Paired t-test calculation between pre and post sub-maximal exercise

	t	t_{table}
Placebo	-4.571	2.447
Supplement	-3.063	
$p < 0.05$		

In order to study the effects of red fruit extract supplementation on blood lactate concentration after sub-maximal exercise, the independent t-test of blood lactate concentration of post exercise and the increased value (post-pre) was calculated. As shown in figure 1, the increase of blood lactate concentration after performing sub-maximal exercise of supplement group was lower compared to that of the placebo group, however independent t-test calculation showed no significant differences between the placebo and supplement group, as noted in table 4.

Table 4: Independent t-test calculation between placebo and supplement group.

	t	t_{table}
Placebo	0.621	2.447
Increased (Post-Pre)	0.844	
$p < 0.05$		

Although large numbers of studies have demonstrated that the addition of antioxidants can improve muscular performance, a benefit of antioxidant supplementation is still under debate (Draeger et al., 2014). Moreover a review study on antioxidant and exercise concluded that there is limited evidence showing that antioxidant supplementation improves human performance (Powers and Hamilton, 1999). A comprehensive study on the effect of antioxidant supplementation on exercise performance has suggested that acute doses opposed to chronic consumption of antioxidant supplementation may be more beneficial (David et al., 2015). It should be noted that in this study red fruit extract supplementation and sub-maximal exercise were given occasionally.

4 CONCLUSION

The main finding of the present study was that both placebo and supplement groups experience increases of blood lactate concentration after sub-maximal exercise. Although the increase of blood lactate concentration after sub-maximal exercise from supplement group was lower than that of the placebo group, still there was no significant effect of red fruit extract supplementation found. The utilization of red fruit as a natural source of supplement may promote the local potential of Papua; however, further study of regular and long term dose of red fruit extract supplementation is needed to gain more detailed information on the effects.

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