

## Effect of Beetroot Extract on Maximum Oxygen Volume Athletes

**Arimbi<sup>1</sup>, Arifuddin Usman<sup>2</sup>**

Universitas Negeri Makassar<sup>1,2</sup>

Email : arimbi@unm.ac.id

**Abstract.** Beetroot is high in nitrate and iron content which affects the value of the maximum oxygen volume (VO<sub>2</sub>max) which is important for athlete's stamina. This study to intend analyze the effect of beetroot juice on the VO<sub>2</sub>max value of badminton athletes. This type of research is true experiment with the pretest-posttest control group design approach. The research subjects were 36 badminton athletes, divided into three groups, namely the 300 ml group, the 200 ml group and the control group. VO<sub>2</sub>Max value was measured by the Multistage Fitness Test (MFT) method. Data analysis used paired t-test, independent sample t-test, repeated ANOVA and one way ANOVA. The results of this study showed that there was a significant change in the value of maximal oxygen volume (VO<sub>2</sub>max) of athletes after the intervention of giving beetroot juice for 15 treatments, the VO<sub>2</sub>max value concluded with the delta value, it can be seen that changes in the increase in VO<sub>2</sub>max value in each group are 5.7 ml / kg / minute in the group given 300 ml and 3.7 ml / kg / minute in the 200 ml group, and the lowest increase in the control group was 2.7 ml / kg / minute. The increase in VO<sub>2</sub>Max value was due to an increase in hemoglobin levels which was triggered by the iron content in beetroot as well as the high nitrate content in beetroot which was given during the intervention.

**Keywords:** Beetroot, athlete, VO<sub>2</sub>max

### INTRODUCTION

Cardiorespiratory endurance is the ability of the heart, lungs, and blood vessels to function optimally when working to take up oxygen maximally (VO<sub>2</sub>MAX) and distribute it throughout the body, especially in active tissue so that it can be used for the body's metabolic processes. To measure the cardiorespiration resistance, it can be done by measuring the maximum oxygen consumption. VO<sub>2</sub>Max is the maximum amount of oxygen that can be consumed during intense physical activity until fatigue occurs. Cardiorespiratory resistance in males peaks at the age of 18-25 years along with the peak growth of muscle mass (Jelalian et al, 2008). Cardiorespiratory resistance in a man is said to be good if he gets a VO<sub>2</sub>Max value of 44-52.9 ml / kg / minute (Haqberg et al, 2001).

Provision of special foods or drinks is also important to increase VO<sub>2</sub>Max for an athlete. One of the substances that can optimize VO<sub>2</sub>Max levels is the nitrate content found in food ingredients. Beetroot is a food ingredient that contains lots of nitrates. Tubers derived from beet plants (*Beta vulgaris*) have a distinctive purplish red color due to the presence of betalain pigments. In 500 ml of beetroot juice, which is approximately 750 grams of beetroot, in 500 ml of beetroot juice contains as much as 5.1 - 6.2 mmol of nitrate. Several studies have proven the effect of beetroot on pulmonary oxygen uptake (VO<sub>2</sub>). Research conducted in 2010 in the UK which states that consumption of inorganic nitrate (5.1 mmol nitrate / day) from 500 ml of beetroot juice for 6 days can reduce pulmonary oxygen uptake (VO<sub>2</sub>) in strenuous exercise so that it can delay fatigue time in an athlete (Safitri., 2015).

Using beetroot (*Beta vulgaris*) in the field of sports is still very less and even very rare for an athlete to know about the benefits of beetroot. One of the potential or benefits of beetroot that has not been utilized in the field of sports nutrition is that beetroot can increase the stamina of an athlete with an indication that beetroot can increase the VO<sub>2</sub>Max of an athlete with nitrate content which biologically affects the regulator of O<sub>2</sub> utilization by muscle contractors so that O<sub>2</sub> distribution is in accordance with muscle requirements (Dieny et al., 2017). From this description, this research will analyze the effect of the nitrate content in beetroot juice on the increase in the maximum oxygen volume value of badminton athletes.

## **RESEARSH METHODS**

The research method used is true experiment with a pretest-posttest control group design approach, which is a design that provides a preliminary test to two randomly selected groups, to determine the initial state, to see the differences between the experimental group and the control group. The samples used in this study were 36 athletes, divided into three groups, namely 12 athletes in the 200 ml beet juice group, 12 athletes in the 300 ml beet juice group, and 12 athletes in the control group. Data analysis used paired t-test, independent sample t-test, repeated ANOVA and one way ANOVA.

## **RESULT AND DISCUSSION**

Characteristics of respondents measured before treatment included age, weight and height

Table. 1 Characteristics of Research Subjects in Three Groups

Subject description	Beetroot extract 300 (n = 12)	Beetroot extract 200 (n = 12)	Kontrol (n = 12)
	Rerata	Rerata	Rerata
Age	20,08	19,50	19,58
Body Weight	59,63	62,09	57,53
Height	166,92	166,58	165,75
VO2Max before	43,69	39,85	38,53
VO2Max after	49,39	43,57	41,26

Table 1 shows that for the age of the respondents in the three groups there is no significant difference between the three groups, and for body weight and height between the three groups there is also no significant difference between the three groups ( $p > 0.05$ ).

Table 2. Comparative Analysis of VO2max Value Before and After Intervention

Groups	Beetroot extract 300 (n = 12)			Beetroot extract 200 (n = 12)			Plasebo (n = 12)		
	mean	SD	P	mean	SD	P	mean	SD	p
VO2Max									
Pre Intervensi	43,69	5,92	0,000*	39,85	6,94	0.007**	38,53	7,21	0.007**
Post Intervensi	49,39	6,17		43,57	6,26		41,26	5,90	

The control group, 200 ml treatment group and 300 ml treatment group each consisted of 12 respondents. The difference in the effect of giving beetroot juice on the VO2max value of each group, namely in the 200 ml treatment group from an average value of 39.85 ml / kg / min to 43.57 ml / kg / min, in the treatment group 300 ml of the mean value. -Mean VO2max 43.69 ml / kg / min after 15 days of intervention was 49.39 ml / kg / min. Meanwhile, in the control group that was given rose syrup placebo there was also a change from 38.53 ml / kg / min to 41.26 ml / kg / min.

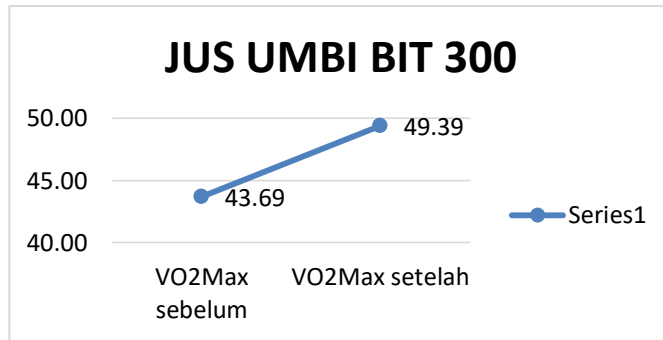


Figure 1. Diagram of Increase in VO2Max Value Before and After Intervention in the Intervention Group 300 ml Beetroot Juice

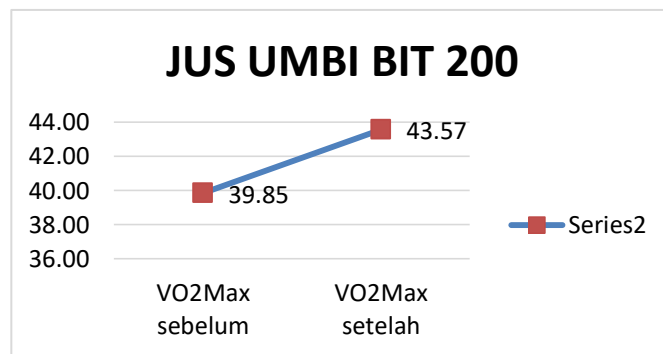


Figure 2. Diagram of Increase in VO2Max Value Before and After Intervention in the Intervention Group 200 ml Beetroot Juice

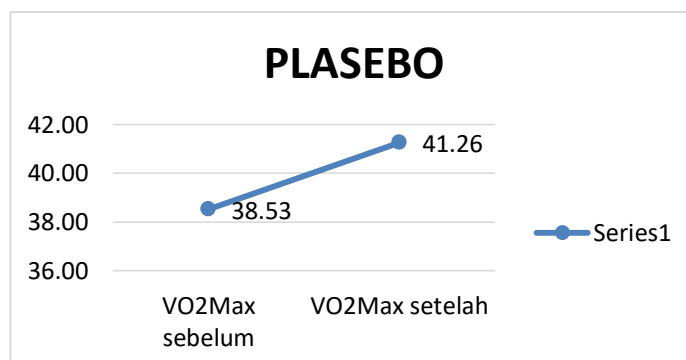


Figure 1. Diagram of Increase in VO2Max Value Before and After Intervention in the Control Group

## DISCUSSION

This study was conducted to determine the effect of beetroot juice on the value of the maximal oxygen volume (VO<sub>2</sub>max) of badminton athletes. The study was conducted at the Badminton Sports Hall, Faculty of Sport Sciences, Makassar State University, involving a total of 36 samples who were badminton players who joined and were active in badminton BKMF with Aged 18-25 years, were randomly divided into 3 (three) research groups, namely the group with 300 ml of beetroot juice, 200 ml of beetroot juice and 1 (one) control group who were given a substitute for beet juice with syrup as a placebo. The study was carried out for 15 days in that time the sample was given beet juice intervention every afternoon before starting the exercise, as well as the control group, given syrup every afternoon before training.

Post-test measurement of VO<sub>2</sub>Max value was carried out on the 16th day after the intervention for 15 consecutive days. The VO<sub>2</sub>Max measurement test was carried out twice, namely at the beginning before giving the intervention and on the 16th day after giving the intervention for 15 days. The value of cardiovascular endurance measurement (VO<sub>2</sub>Max) in 3 groups each experienced a significant increase, but the highest increase in VO<sub>2</sub>Max value was in the group that was given the intervention of 300 ml of beet root juice. The values obtained were in the group with the intervention of 300 ml of beetroot juice the average VO<sub>2</sub>Max before intervention was 43.69 ml / kg / minute and after the intervention an average of 49.39 ml / kg / minute. In the 200ml group the mean VO<sub>2</sub>Max value before 39.85 ml / kg / minute and after the intervention averaged 43.57 ml / kg / minute. The control group the initial VO<sub>2</sub>Max value averaged 38.53 ml / kg / minute and after that it became an average of 41.26 ml / kg / minute. With the delta value, it can be seen that there is a change in the increase in VO<sub>2</sub>max value in each group, namely 5.7 ml / kg / minute in the group with the administration of 300 ml and 3.717 ml / kg / minute in the 200 ml group, and the lowest increase in the control group. which is 2,725 ml / kg / minute. The increase in VO<sub>2</sub>Max value was due to an increase in hemoglobin levels and high nitrate content in beetroots given during the intervention. Vegetables provide more than 80 percent of nitrate intake, while based on the 24 recall obtained by almost all athletes in the three groups studied did not have a habit of consuming vegetables, the nitrate value was obtained only in the group given 300 ml which during the intervention period was recorded to consume an average of 0, 1 mg with the consumption of vegetables once for two weeks, apart from the absence of eating arrangements, fast food is more attractive to athletes because it is easy in the manufacturing process, so that nitrates and the positive effects that occur during the intervention are only obtained from beetroot juice given.

Nitrates in the body will be converted into nitrogen monoxide (NO), which is a chemical that can activate other chemicals in the process of vasodilation of blood vessels caused by relaxation of smooth muscle cells in the walls of arteries and veins. Vascular vasodilation also determines the distribution of oxygen in the blood that

can be distributed throughout the body optimally, this prevents fatigue and muscle cramps and various risks of other sports injuries, in other words, the high nitrate content in beetroot juice can increase the athlete's VO<sub>2</sub>Max which biologically affects the utilization regulator. O<sub>2</sub> by muscle contractors so that the distribution of O<sub>2</sub> is in accordance with muscle needs and nitrate supplementation up to the 15th day can increase the mitochondrial mass thus also increasing the use of NO (Nitric oxide) in the mitochondria in producing energy (Vanhatalo et al, 2010), therefore, recommendations The duration of administration of beetroot juice is more than 15 days for endurance athletes such as badminton athletes.

## **CONCLUSION**

There was a significant increase in the VO<sub>2</sub>Max value in badminton athletes after consuming beetroot juice, both in the 300 ml beetroot juice group, the 200 ml beetroot juice group and in the control group, and there was a significant difference in the VO<sub>2</sub>Max value in each group of athletes. badminton after treatment between 300 ml beetroot juice treatment group and 200 ml beetroot juice treatment group.

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