

THE IMPACT OF BANANA CONSUMPTION ON THE LOWER EXTREMITY MUSCLE RESISTANCE (A Case Study from Male Student of Medicine Faculty, Universitas Jenderal Achmad Yani)

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DOI: <https://doi.org/10.15520/ijmhs.v10i12.3181>

Accepted 25/11/2020; Received 20/10/2020; Publish Online 31/12/2020

ABSTRACT

Increasing the endurance performance of the lower limb muscles can not only be helped by the type and method of exercise, but consumption of the right nutrition. Bananas are one of the nutrients with a source of carbohydrates, sugar and the mineral potassium which can help the process of muscles to contract during exercise.

The purpose of this study was to determine the effect of giving bananas on lower limb muscle endurance. And also, what is the proper mechanism for banana consumption to increase muscle endurance in the lower extremities. This research method is a quasi experimental method, with a pre-test and post-test design. Subjects were taken through probability sampling techniques with simple random sampling method. Subjects filled out a list of questions and agreement sheets, then in the pre-test, the subject pedalled an ergometer until the research subject was unable to continue the test or reached a maximum heart rate. The post-test was continued two days later by being given a banana one hour before the test and then pedalling an ergometer bicycle until it reached the same limit as the pre-test. The research results were analysed using the t test.

There is a significant effect by bananas consumption on the endurance of lower extremity muscles. This shows that giving bananas is very beneficial for individuals who will do sports so that they can increase their endurance.

Consuming 2 bananas before doing activities, especially before exercising, can increase the endurance of lower limb muscles and physical fitness, except for people with kidney disease. The right time to consume bananas is 60 minutes before exercising. This consumption can be done again if you want to continue sports or other activities after experiencing fatigue.

Further research is needed by measuring potassium levels in the body which affect the results of giving bananas on muscle endurance so that the results obtained are more objective. In addition, for further research, there is a need for a uniform cycling technique, especially the pedaling position with the bicycle ergometer test when measuring the endurance of the muscles of the lower extremities so as not to affect the results of the study.

Key words: Lower limb muscle endurance–Banana Consumption

1 INTRODUCTION

Sports is one of the activities that is useful in maintaining a healthy body. Sports is a form of planned and structured

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**THE IMPACT OF BANANA CONSUMPTION ON THE LOWER EXTREMITY
MUSCLE RESISTANCE (A Case Study from Male Student of Medicine Faculty,
Universitas Jenderal Achmad Yani) 1467**

physical activity that involves repeated body movements and is aimed at improving physical fitness.¹ Physical fitness is the ability to carry out activities and adaptation to physical loads without causing excessive fatigue and still having reserves. important in helping with daily activities, but the level of physical fitness varies depending on each profession such as athletes who have a better physical fitness level than non-athletes.

Physical fitness has several components related to health, namely body composition, body flexibility or flexibility, heart and lung endurance, muscle strength and muscle endurance.^{1,2} Muscle strength and muscle endurance are important components in carrying out high intensity activities. Muscle strength is the maximum contraction produced by muscles to generate tension against a resistance, while muscle endurance is the ability to contract continuously within a certain time.

Various methods of exercise can affect the muscular endurance of the entire limb or specifically affect one part of the limb. The endurance of the lower limb muscles can be trained using an ergometer test bike which is a stationary bicycle that allows for precise load measurements. The bicycle ergometer test is a sub-maximum test that can estimate physical fitness, especially muscle endurance.^{4,5}

Increasing physical fitness performance, especially the endurance of a person's muscles in the body, not only from the type and method of exercise, but consumption of proper nutrition can also help increase this.⁶ Consumption of additional nutrients needed to be an additional source of energy to help improve physical fitness performance, namely carbohydrates, fats, protein, vitamins, water, and minerals. Vitamins and minerals must be in adequate amounts to help improve physical fitness.⁷ Minerals are one aspect that acts as a source of additional energy which is an element in simple inorganic form.

Minerals are classified as macro food substances, which are required in large quantities, and micro substances, which are required in small amounts, which are required in the regulation of food. Minerals are also needed for good health and normal body function.⁷ There are many mineral substances needed by the body that can help improve physical fitness, especially in muscle endurance, one of which is potassium (K⁺).⁸ The mineral potassium is related to endurance muscles because the potassium content in muscles is related to muscle mass and glycogen reserves.⁹ Potassium during exercise functions as muscle endurance, strength and speed of muscle contraction, fluid and acid-base balance, and glucose transporters in cells.¹⁰ Potassium levels when we are high, especially when exercising will come out of the muscle cells so that there will be a decrease in potassium levels in the muscles. Decreasing potassium levels can be helped by intake of foods containing high potassium levels.¹¹

Food sources that contain the mineral potassium can come from fruits, vegetables, fresh meat and dairy foods. One of the foods that contain high potassium minerals is bananas. Bananas have many genome groups, one of which is the Cavendish banana which is the AAA.⁹

Bananas are an inexpensive source of energy and are used by athletes because they are considered a source of carbohydrates for the main energy in exercise and the mineral potassium.¹² One banana can provide 23% of daily potassium needs. Different types of bananas have different levels of potassium but are still high in potassium. The potassium in bananas is important in helping muscles to contract during exercise, especially during the ecstasy-muscle contraction process and can prevent muscle cramps or spasms during exercise.¹³ In Miller's (2012) study, it was explained that there is a relationship between consuming bananas and the level of plasma potassium concentrations measured by blood sampling. The results of these studies indicated that there was an increase in the level of plasma potassium concentration at 30 and 60 minutes after consuming two bananas (300 grams).¹⁴

The existence of the results of the research that has been done, makes researchers feel interested in conducting this research. This study aims to study the effect of banana application on lower limb muscle endurance. In addition, what is the proper mechanism for banana consumption to increase muscle endurance in the lower extremities.

2 METHODOLOGY

The quasi-experimental method was used in this study with a pre-test and post-test design. The selection of research subjects was determined through simple random sampling technique. This research was conducted at the Physiology Laboratory of the Faculty of Medicine, UNJAN. The subjects were 24 male students of Medicine Faculty who had met the inclusion criteria, namely: men, aged 19-23 years; have a healthy body; did not consume food less than 6-8 hours before the study (especially not consuming potassium rich foods); no strenuous exercise within the 24 hours preceding the study; drinking water consistently before the study; and not included in the exclusion criteria, namely: had a history of lower limb trauma or a history of lower limb surgery in the 6 months prior to the study and did not have neurological, cardiovascular, kidney and muscle disorders.

Screening of research subjects was carried out through distributed concent informed sheets. The final screening was carried out through the provision of forms and a simple history taking some time before the study was carried out, regarding the preparation of the subject before the study was carried out. The research subjects understood the objectives and procedures and volunteered to take part in the research.

If the subject has met all the criteria for the preparation of the study, the procedure is continued by conducting tests before giving bananas. When the test is over, it is continued two days later with a banana one hour before the test is carried out.

The research data obtained regarding the differences in the level of muscle fatigue on the bicycle ergometer test with the provision of bananas and analysed using statistical tests to make the research more valid on the results of

the research conducted, namely by using the t test to determine whether there was a difference in the endurance of the lower limb muscles before and after giving bananas using a statistical software program.

3 RESULT AND DISCUSSION

Description of Age and Body Mass Index (BMI) of Research Subjects

Factors that can affect the duration of a person's lower limb muscle endurance are age and body mass index (BMI). An overview of the age and BMI of research subjects is presented in Table 1. below:

Based on the results of the uni variable analysis of the age of the research subjects, it was found that the mean age was 21.13 years with the youngest being 20 years and the oldest being 23 years. Age is a factor that affects the endurance of lower limb muscles in each individual, but in this study age was considered homogeneous with an age range of 20 to 23 years. At the initial age of 20 years is the peak of muscle strength and endurance.¹⁵

The results of the uni variable analysis of body mass index (BMI) showed that the mean BMI was 26.61 kg / m² with the lowest BMI of 21.63 kg / m² and the highest was 36.85 kg / m². Most of them have BMI with obesity type 1 category. Body mass index (BMI) is a factor that can affect the endurance of lower limb muscles. A high BMI indicates high levels of fat or muscle mass and affects the physical fitness of an individual, if fitness decreases, the endurance of the lower limb muscles will decrease.¹⁵

Overview of Lower Extremity Muscle Endurance (Pre-test and Post-Test)

The following table provides information related to lower limb muscle endurance and the average duration of muscle endurance in each study subject between before and after treatment.

The table above shows that the average duration of lower limb muscle endurance during the pre-test (before consuming bananas) is 889.67 seconds with a standard deviation of 461.09 seconds. Meanwhile, the average muscle endurance after consuming bananas increased to 2353.13 seconds with a standard deviation of 1.399.52 seconds. From the table it was also found that the minimum muscle endurance duration in this study was 535 seconds and the maximum duration achieved in this study was 5,900 seconds. The value of 95% Confidence Interval (CI) in the data before giving bananas was between 694.96 to 1.084.37, while for after giving bananas it was between 1,762.16 to 2,944.09. This shows that there is an average difference in the description of lower limb muscle endurance before and after giving bananas can be explained in Figure 1 below:

The results of the average difference in Figure 1 show the significant mean endurance of the muscles of the lower extremities between before consuming and after consuming banana. This difference shows the difference in leg muscle endurance before and after consuming bananas of 1,464.46 seconds. This difference explains the differences in the en-

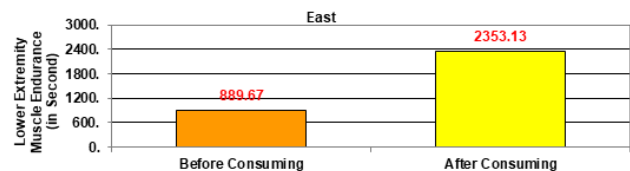


Figure 1. Mean of Lower Extremity Muscle Endurance

durance picture of the muscles of the lower extremities before and after consuming banana.

The Effect of Banana Consumption on Lower Extremity Muscle Endurance

Before testing the hypothesis about the effect of giving bananas on lower limb muscle endurance, the data normality test is first performed.

The results of the normality test with the One-Sample Kolmogrov-Smirnov test showed that the data distribution of the dependent variable, namely the muscle endurance of the lower extremities and the distribution of bananas, was normally distributed ($p > 0.05$), so the test used was the dependent t test for paired data and each data. or research subjects were measured twice.

Table 4 shows that there is a negative average result of the t test with a result of -1.463.458 seconds with a standard deviation (SD) of 1.067.114 seconds. This shows that the average duration of lower limb muscle endurance after consuming bananas is longer than before consuming bananas because the principle of calculating the average statistical in the t test is that the data before consumption of bananas is reduced by the data after consuming bananas so the results will be negative if the data after consuming more bananas. These results also indicated that there was an effect of giving bananas on lower limb muscle endurance in the study subjects with a value of $p = 0.000$ ($p < 0.005$) and had a negative average of -1.463.458 seconds which showed a strong enough effect.

The value of 95% Confidence Interval (CI) was between -1.914.06 to -1.012.85. This value means that with a 95% confidence level if the measurement is carried out on the sample, the difference in the duration of muscle resistance of the lower extremities before and after giving bananas is between -1.914.06 to -1.012.85.

These results indicate that there is a strong correlation between banana consumption and limb muscle endurance by comparing the average which strengthens the t-test results which are statistically significant. In addition, it can be concluded that there is an effect of banana consumption on lower limb muscle endurance in the study subjects because the mean muscle endurance of the lower extremities after giving bananas is greater than before giving bananas.

These results are supported by research shown by Miller (2012) which states that there is an effect of giving bananas to the level of potassium plasma concentrations as measured by blood sampling which is statistically significant for men who exercise. The level of plasma potassium concentration that increases at 30 and 60 minutes after consuming two bananas (300 grams) shows an effect on performance in

**THE IMPACT OF BANANA CONSUMPTION ON THE LOWER EXTREMITY
MUSCLE RESISTANCE (A Case Study from Male Student of Medicine Faculty,
Universitas Jenderal Achmad Yani) 1469**

Table 1. Age and Body Mass Index (BMI) of Research Subjects

Confounding factors	Mean	SD	SE	Min	Max	
AGE	24	21,13	0,741	0,151	20	23
BMI	24	26,61	3,89	0,79	21,63	36,85

Table 2. Overview of Lower Limb Muscle Endurance Before and After Consuming Banana

INDICATOR	Mean (in second)	SD (in second)	95% CI (second)		Min (in second)	Max
			Lower	Upper		
Before Consuming	24	889,67	461,09	-694,96	-1.084,37	2105
After Consuming	24	2.353,13	1.399,528	-1.762,16	-2.944,09	535

Table 3. Normality Test

INDICATOR	Mean (second)	SD (second)	Pvalue
Before Consumption	24	889,67	0,706
After Consumption	24	2.353,13	0,239

*One-Sample Kolmogorov-Smirnov Test

Table 4. Effect of Banana Consumption on Lower Limb Muscle Endurance

DESCRIPTION	Mean (secon)	SD (second)	SE (second)	95% CI (second)		Pvalue
				Lower	Upper	
Before and After Banana Consumption	- 1.463,458	1.067,114	217,824	-1.914,06	-1.012,85	0,000

the body, especially when the study subjects exercise which helps when muscle contraction so that there is an increase in muscle endurance in the study subjects.¹⁴

The results of this study were taken from the results of measuring the endurance of the muscles of the lower extremities using the bicycle ergometer test method where the main focus of the working muscles is the quadricep and hamstring muscles in the upper muscles and the gastrocnemius and soleus muscles in the calf of the leg which contract in a series of times.^{15,16} The process of contraction is assisted by the type of slow muscle fibers that can support lower limb muscle endurance.¹⁷⁻¹⁹ The endurance of these lower limb muscles can be affected by age, gender, body fat levels, various training methods that can increase muscle endurance and nutrition.^{14,15} One way that can help is the provision of nutrients such as bananas, which was carried out in this study.

Bananas have a lot of carbohydrates which will produce high energy. The results of the catabolism of these carbohydrates will produce ATP as an energy source for muscle contraction which affects muscle endurance. The higher the energy source obtained for muscle contraction, the muscle endurance will also increase. In addition, bananas have potassium which has a significant effect on muscle work processes. The high potassium content in bananas affects the membrane potential, especially in the excitation-contraction process of muscles. When muscle activity increases (i.e. when pedaling an ergometer) there is a decrease in intracellular potassium and an increase in extracellular potassium.²⁰⁻²³ When there is an increase in muscle activity it will develop into muscle fatigue accompanied by an increase in extracellular potassium.^{17,18} Banana consumption

affects the endurance of the muscles of the extremities along with increasing muscle activity of the lower extremities with the duration of riding an ergometer bicycle when the potassium content in bananas adds intracellular potassium levels so that the endurance of the lower limb muscles increases which helps in the excitation-contraction process of the muscles.²⁰⁻²³

The increase in muscle endurance in research subjects is also supported by a high energy content of 90 kcal, 12 g of sugar, and 22.84 g of carbohydrates which also act as a source of energy in carrying out muscle contraction activities, especially when the muscles of the lower extremities contract.^{24,25} From that, it can be said that bananas have an effect in increasing the endurance of the muscles of the lower extremities.

4 CONCLUSION

There is a significant effect by bananas consumption on the endurance of lower extremity muscles. After giving bananas, there was an increase of 164,61% of the lower extremity resistance than before being given bananas. This shows that giving bananas is very beneficial for individuals who will do sports so that they can increase their endurance.

Consuming 2 bananas before doing activities, especially before exercising, can increase the endurance of lower limb muscles and physical fitness, except for people with kidney disease. The right time to consume bananas is 60 minutes before exercising. This consumption can be done again if you want to continue sports or other activities after experiencing fatigue. Cavendish types can be used as the main

choice for bananas because they contain better when compared to other bananas.

This is as stated by Miller's (2012) which shows that there was an increase in the level of plasma potassium concentration at 30 and 60 minutes after consuming two bananas (300 grams).¹⁴

Further research is needed by measuring potassium levels in the body which affect the results of giving bananas on muscle endurance so that the results obtained are more objective. In addition, for further research, there is a need for a uniform cycling technique, especially the pedalling position with the bicycle ergometer test when measuring the endurance of the muscles of the lower extremities so as not to affect the results of the study.

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