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by I Wayan Juniarsana, Iga Ayu Dharmawati

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Administration of Pismatom Juice in Increasing the Energy Efficiency In Middle-Distance Run Athletes of PASI Denpasar, Bali-Indonesia

I Wayan Juniarsana^{1*}, IGA Ayu Dharmawati²

^{1, 2} Polytechnic of Health Denpasar

*Corresponding Author: I Wayan Juniarsana, E-mail: wjuniarsana9@gmail.com

ABSTRACT

Adequate nutrition supply the source of energy and the efficiency of using it, is required to achieve peak performance in middle-distance running athletes. Giving a mixture of banana honey tomato (*Pismatom*) juice provides energy, electrolyte and antioxidants during exercise. This study aims to prove that *Pismatom* juice administration increases energy efficiency. Subjects of were 28 males athletes divided into 2 groups with randomized pre-posttest control group design. The treatment group was given 240 cc of *Pismatom* juice and control group was given 240 cc of mineral water before and after physical exercise for 14 days. The results showed that speed time run 2,4 Km control group obtained average 11.25+ 1.63 minutes (pretest) and 11.37+1.97 minutes (post test), while treatment group averaged 11.34 + 1.28 minutes (pretest) and 11.06 + 1.16 minutes.(post test). Heart rate in control group was 164.00 + 15.13 beats/minute and treatment group was 155.36 + 19.72 beats/minute. Average energy efficiency in the control group was 65.76 + 16.85% and treatment group was 51.66 + 10.93%. The energy efficiency in treatment group 51.66 ± 10.93% vs 65.76 ± 16.85 % showed significant difference (p<0.05). It is concluded that *Pismatom* juice administration increased energy efficiency in middle-distance running athletes.

Keywords: *Pismatom* juice, energy efficiency and middle-distance run

INTRUCTION

Running athletes must be able to maintain energy balance obtained from food, fluids, supplement products which is in balance with the energy released. Energy expenditure and body fluids in the form of sweat and breathing on physical activity can increase body temperature which is able to interfere metabolic processes and reduce electrolytes levels which have an impact on decreasing physical performance. The recovery acceleration and running time are the indicators of athlete's performance improvement. Athlete's performance must be carried out with the principle of efficiency energy use to achieve maximum performance goals [1]. The role of adequate nutrition containing electrolyte fluids, carbohydrates, ready-to-use energy and antioxidants needs to be given to moderate-high intensity athletes to support athlete performance and efficient use of body energy [2]

Carbohydrate containing drinks which are given during prolonged physical exercise can prevent dehydration and reduce the effects of lack of fluids on cardiovascular function and exercise ability and slow the occurrence of fatigue. Drinks that contain electrolytes, carbohydrates, minerals (potassium) and high antioxidants with a slightly sweet, cool and natural taste can be obtained from fruit juices made from bananas, honey and tomatoes called *Pismatom* juice. A study states that consuming 150-300 grams of bananas can increase potassium and blood glucose levels 30-60 minutes after digestion, so this is potential to prevent fatigue [3]. Physical fitness increases through maximum oxygen uptake in athletes by consuming honey before and after exercise for 7 consecutive days [4]. Giving tomato juice before and after exercise accelerates recovery in boxing athletes [5]. Honey is another source of carbohydrate which is immediately used as energy during exercise.

METHOD

This study was an experimental, using one group pre-test and post-test design [11]. The number of subjects were 28 middle run athletes who are members of PASI Kota Denpasar with a membership of at least 2 years at the time this study was conducted, male sex, age 14-18 years, body mass index (BMI) category 18.5 - 24, 9. The study was conducted by measuring the heart rate, speed time, energy expenditure

and percentage of energy efficiency. *Pismatom* juice was given to the athletes in treatment group. *Pismatom* juice is made with banana, honey, and tomato. *Pismatom* juice is given to athletes with composition of 240 cc volume and consist of 100 grams banana, 10 grams honey, 100 grams tomato and 30 cc of water (240 cc volume) during 14 days in middle-distance runner. *Pismatom* juice was given 30 minutes before and immediately after exercise. On the 14th days after exercise training program a remeasurement of exercise heart rate, speed time, energy expenditure and percentage of energy efficiency were conducted. According to, energy efficiency using Brooks and Fahey (1985) formula that energy efficiency percentage was calculated by recovery heart rate and speed time compare with energy expenditure. The SPSS (17) software was used to data management and analysis, while Microsoft Excel was used for charts. The results were expressed as mean \pm standard deviation of the mean. Statistical analysis was carried out using t-independent test and $p < 0.05$ was accepted as significant.

RESULT

1 Subject Characteristics

The number of subjects in this study were 28 middle-distance run athletes of Athletic Association (PASI) in Denpasar. The characteristics of the subject can be seen in Table 1 below.

Table 1. Characteristics of Research Subjects

Variable	n	Control Group Average \pm SD	Treatment Group Average \pm SD	t	p*
Age (years)	1	15,36	15,29 \pm	0,4	0,68
	4	\pm 1,50	1,33	3	3
Weight (Kg)	1	54,24	56,69 \pm	-	0,25
	4	\pm 4,79	6,17	1,1	0
Height (cm)	1	167,84	167,94	-	0,96
	4	\pm 5,63	\pm 6,55	0,4	6
Body Mass Index	1	19,34	20,08 \pm	-	0,16
	4	\pm 1,04	1,61	1,4	3
Heart Rate Training (beats/minute)	1	164,00	155,36	1,3	0,20
	4	\pm 15,13	\pm 19,72	0	5

Noted:

p^* The normal data distribution $p > 0,05$

2. Nutritional Composition of *Pismatom* Juice

Nutritional analysis of *Pismatom* juice was conducted at Food and Technology Laboratory Unit, Udayana University [11] with the composition of 240 cc volume (serving portion) i.e ; energy 149,55 Kcal, carbohydrate 119,02 gr, protein 6,62 gr, fat 0,45 gr, fibre 2,13 mg, sodium 19,57 mg, potassium 292,5 mg, flavonoid 0,4719 (mg/1000E), antioxidant capacity 14,59%, vit. C 22, 162 mg/100gr, sucrose 96,336 mg, water soluble 201,54 gr.

3. Efficiency Energy Analysis

Adequate energy for an athlete and efficiency of energy use are absolutely important to achieve peak performance. The efficiency of energy expenditure in physical activity is affected by working ability, intensity of physical exercise and total energy used. The performance of a running athlete, especially

middle-distance can be shown through the speed time to get finish line. The results of the research showed that speed time for 2,4 km in the initial data control group (pre test) obtained average of 11.25 + 1.63 minutes and final data control group (post test) showed average of 11.37 + 1.97 minutes. While in the initial data treatment group (pretest) shown an averaged of 11.34 + 1.28 minutes and post test data shown an average of 11.06 + 1.16 minutes. Based on the data, the Pismatom Juice treatment group showed better performance by average speed time of 0.31 minutes faster than the mineral water group.

Based on the average heart rate during the exercise in both groups, the Control group was 164.00 + 15.13 beats/minute and in the Treatment group 155.36 + 19.72 beats /minute. Meanwhile, the average energy expenditure seen from the total energy expenditure in the two groups, including the control group was 2935.2857 + 253.81 Kcal/day and the Treatment group was 3236.78 + 354.33 Kcal/day. The average of total energy expenditure in both groups is classified as the category of energy expenditure in high intensity exercise [12]

Based on the parameters of travel time speed, exercise heart rate and total energy expenditure, therefore the level of energy use (efficiency %) in both groups can be measured by the formula proposed by Brooks and Fahey [14]. The average of efficiency energy in the Control Group was 65.76 + 16.85% and in the Treatment Group it was 51.66 + 10.93%. The results of data variance homogeneity test on the average of energy efficiency in both groups obtained $p = 0.066$ ($p > 0.05$), which means that the data variance is homogeneous. The results of t-independent test on the level energy expenditure use in both groups can be seen in Table 2.

Table 2. Energy Efficiency Difference
In the control and treatment groups

Group	n	Energy Efficiency Percentage (%)	t	p
Control	14	65,76 ± 16,85	2,627	0,014
Treatment	14	51,66 ± 10,93		

The analysis results in Table 2 showed that there was a significant difference in energy efficiency with a value of $p=0.014$ ($p < 0.05$). Based on the GLM analysis results to the treatment group, energy use was 10.956 higher by controlling age and body mass index (BMI) (coefficient = 10.956) variable. These results indicate that the Pismatom juice intervention was more efficient in energy use by 11%, compared to the Control Group.

DISCUSSION

Energy needs for an athlete must be adjusted to the amount of energy expenditure (Energy Expenditure) to carry out daily activities, especially physical exercise. According to Brooks and Fahey [14], energy efficiency can be determined by many factors such as ; running speed, intensity, and total energy expenditure. Study result showed that the level of energy use to the athlete's performance was 51.66% in the Treatment Group. Meanwhile in Control Group was 65.76%. The result of statistical analysis showed that there was a significant difference ($p < 0.05$) in the level of efficiency energy use to the athletes performance. The GLM analysis results showed that the Pismatom juice intervention was more efficient in energy use by 11% compared to the Control Group. This proved that the use of energy to achieve athlete performance is more efficient by consumed Pismatom juice compared to mineral water.

This study result are in line with Ivy's research [15], which revealed that administration of food contain carbohydrates as much as 0.2 grams/kg body weight before and after 2 hours session cycling exercise, increase the working capacity and efficiency of energy use by 11% in the last 30 minutes of a training session.

Administration of Pismatom juice containing high carbohydrate that made with bananas and honey have a positive effect to the athlete performance and energy efficiency. According to Irawan (2007),

carbohydrates that is consumed during exercise can be stored in the liver, therefore when the body need an additional energy, the liver will release of glucose into the bloodstream to maintain the blood glucose levels and the rate of carbohydrate-burning proses. Carbohydrates-burning proses as the body's main energy source will increase by up to 100% when the exercise intensity of 70-95% VO₂ Max. This process will help to prevent fatigue and efficiency of the energy use in endurance sports, which are usually have a long duration [16].

Speed is the ability that determines the athlete's achievement in running [17]. The study results that an athlete who consume Pismatom juice before and after physical exercise was 0.31 minutes faster than an athlete who drink mineral water with in 2.4 Km. This result is in line with the results of research by Nieman et al., (2015) proved that consuming bananas as a source of carbohydrates as much as 0.6/kg body weight before and during physical exercise in 75 Km distance runner, can improve athlete performance by 5% compared to a runner who just drink water [18].

Faster travel time in the group who consume Pismatom Juice affects the efficiency level of energy use. This study results are in line with Iaia et al research., (2008) that endurance and speed training during submaximal exercise can reduce the use of energy expenditure by athletes without decreasing the expression of the UCP3 gene (mitochondrial uncoupling protein 3) in mitochondria [19]. According to Soekarman (2005), when the cells need to add on ATP in physical exercise, then mitochondria can replicate. This is possible because mitochondria contain dioxiribonucleotide acid (RNA) which is similar to DNA in the nucleus cells. Mitochondria is one of the most important organelles as a place to form the main energy of cells, such as the provision of ATP and NAD⁺ (nicotinamide adenine dinucleotide) so that it is often referred to as the center of cell energy reserves [20].

To provide energy for cells metabolism, glucose is converted into ATP in mitochondria. Intake of banana honey tomato as a source of energy and potassium, increases muscle contraction during physical exercise. This is occur because of the potential action and energy in the form of ATP which causes a shift in the actin and myosin filaments, thus affecting the athletes performance [21].

The role of Pismatom juice in increasing energy efficiency in middle-distance run due the energy used is effective to increase working capacity, both working capacity of skeletal muscle through speed biomotoric component and working capacity of the heart muscle, which is indicated by exercise heart rate. When a muscle contracts, it does work and requires energy. A large amount of ATP is broken down to form ADP during the contraction process, the greater the amount of work done by the muscle, the greater the amount of ATP that is broken down. Some of this energy is needed to pump calcium and sarcoplasmic ions into the sarcoplasmic reticulum after contraction ends and to pump sodium and potassium ions through the muscle fiber membrane to maintain a suitable ionic environment to form a potential action of the muscle fiber.

Administration 240 cc volume of pismatom juice before and after exercise, contribute 299.1 Kcal of energy or 11.33% of the total energy required for running athletes. The increasing of energy by 11.33% from total energy expenditure is an effort to make a diet formulation that prioritizes natural food ingredients that are suitable for athletes during physical exercise to improve athlete performance. Based on the interviews results to the Treatment Group who consumed Pismatom juice, they physically felt better and fit to perform 14 days exercise program.

CONCLUSION

Generally, this study proved that Pismatom juice can be used as a natural isotonic drink with its electrolytes (potassium), carbohydrates and antioxidants content that contribute to improve athlete performance which is indicated by the increasing of energy efficiency.

RECOMENDATION

Pismatom juice needs to be applied to athletes who conduct a training center (TC) program on a certain event or championship with a monitoring process of administration according to dosage. This is easier and well-organized, therefore oxidative stress can be prevented and minimized, recovery is faster and more efficient in energy used to reach of Athlete's peaks performance.

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