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EFFECT OF HONEY, DATES EXTRACT MIXED WITH WATER, AND SPORT DRINK ENERGY GEL X ON BLOOD GLUCOSE AND LACTIC ACID LEVELS

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Abstract
The availability of glucose is very influential on the performance of athletes. In addition, the level of fatigue can also inhibit performance in the body. One Prevention to minimize the level of fatigue and improve performance by consume beverages rich in carbohydrates. The purpose of this study was to determine the effect of honey mixed with water, date extract mixed with water, and energy gel x on glucose and lactic acid levels. Method: This study used a double-blind crossover design with four periods. This research was conducted in futsal field of Ramuna, Jati Asih, Bekasi. The subjects were 20 students of futsal teams of SMA Future Gate Bekasi with healthy status. Each period of study subjects checked blood glucose and lactic acid levels before playing futsal with moderate intensity (70% -80% HR) for 4 periods. Each period is separated by a washout for 7 days. Glucose and lactic acid levels were measured immediately at 0, 20, 40, and 45 minutes to determine the significant difference in the effect of treatment on glucose and lactic acid levels. Results: The three carbohydrate beverage administration treatments had no significantly different carbohydrate content. Two or more data averages are said to have significant differences if the value (P<0.05). That's group II, III, and IV. There was a significant difference in blood glucose and lactic acid levels between the 20th and 40th minutes and the difference between the 20th and 45th minutes. This can be seen from both values in Group II (P=0.001) where (P<0.05). Conclusion: of the three, honey (Apis mellifera Linnaeus) mixed with water, dates (Phoenix dactylifera) extract mixed with water, and sports drink energy gel X have a significant effect on increasing blood glucose levels and decreasing lactic acid levels in the men's futsal team of Future Gate Bekasi High School.
Keywords: *Sport Drink Energy; Honey; Dates; Blood Sugar; Lactic Acid*

INTRODUCTION

According to Immawati (2011), achievement in a match is influenced by various factors related to success, including athlete technique, athlete psychology during the match, physical fitness level, pre-match training, and consumption of supporting carbohydrates during the match. The availability of blood glucose during training is one of the factors that influences athlete achievement. Adequate nutrients, such as carbohydrates, proteins, and fats, as sources of energy for the body, are closely related to the athlete's diet both during training and during the match (Irianto, 2007). Many athletes do not know the amount of food that is sufficient according to nutritional needs during training or competition, lack calories, and have an unbalanced, that does not match the energy intake needed during the competition (Purba, 2007). Among the consumption of fluids or foods containing carbohydrate compounds are honey, date juice, and others.

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Indonesia has imported dates from various countries, especially from the Middle East. Interest in dates has increased rapidly in Indonesia along with the increasing population and the liking for the characteristics of this fruit (Emi, 2015). Dates in Indonesia are sold by traders ranging from ± IDR 40,000 - IDR 330,000 per Kg (Tamara et al., 2021). Several researchers have seen that the nutrition of one type of date fruit contains around ±80% carbohydrates, ±4% protein, ±0.3% fat, mineral salts, and vitamins, and the glucose and fructose content in dates has a balanced content, this fruit has levels of vitamins and other nutrients that are not inferior to other types (Kemenkes, 2022).

The main source of energy in the human body is carbohydrates, besides protein and fat. In sports conditions, carbohydrates can be processed into energy through aerobic processes (using oxygen) and anaerobic processes (not using oxygen). Carbohydrate metabolism in producing energy for use at light to moderate intensity requires aerobic processes. According to the definition (Wallis, 2013), carbohydrates are one of the nutrients recommended for consumption during training or matches as an energy source. In addition, this compound plays an important role for the body, namely as the main source of energy reserves, which will later be stored in the liver and muscles in the form of glycogen (Almatsier, 2001). The supply of glucose compounds in the blood during exercise can affect the performance of athletes in a match. If the glucose value in the blood decreases, then the function of brain cells will be disrupted due to the lack of carbohydrate intake in the brain, which results in decreased athlete performance on the field (William M.H., 2007). The carbohydrate intake consumed will be processed into glucose through the process of glycogenesis, namely the formation of glycogen, which will be stored in the liver and muscles as a source of energy in humans (Lamb 1984 and Fox 1993). Glycogen will be broken down to produce pyruvic acid through anaerobic glycolysis (without using oxygen) (Ardle et al., 1981). This anaerobic glycolysis reaction is a series of chemical reactions that can produce energy in the body without involving oxygen in the chemical reaction. Anaerobic glycolysis will release energy obtained from glycogen in the muscles and liver. The energy produced will be used and obtain ATP, so that the energy obtained from ATP can be used by the muscles to perform activities (Pate 1984 and Fox et al. 1993). Glycolysis reaction occurs in muscle cell components in anaerobic conditions or without oxygen assistance (Murray, 2005). The anaerobic glycolysis process is very useful for providing energy in a fairly fast time and without oxygen assistance. However, anaerobic glycolysis has a disadvantage, namely producing lactic acid which can inhibit muscle performance and fatigue.

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A person's level of fatigue can arise due to the accumulation of lactic acid in the blood and muscles (Ningrum, 2012). This condition is caused by the body's inability to neutralize the accumulation of lactic acid with the activities carried out by a person. According to (Bal et al., 2015) a person's level of performance, both the duration of time and the level of effort produced, can affect a person's lactic acid levels. Ahmaidi (1996) The level of lactic acid in the blood has a value similar to the value of lactic acid in the muscles. In the arterial blood vessels in the muscles, the pH value of ± 6-7 mmol / l can inhibit the glycolysis process (Howald, 1986). This can reduce the productive metabolic capacity of ATP and inhibit the Ca and Na pumps that are related to muscle contractions (Robergs, 1997). Muscles will lack strength, muscle contractions will weaken, and muscle performance will decrease (Fitts, 1976). This will have an impact on limited performance (Falk, 1995).

The value of lactic acid in the blood has a value similar to the value of lactic acid in the muscles (Ahmaidi, 1996). The normal value of lactic acid in the blood also has several categories, including at rest and in healthy conditions, namely 1-2 mmol / l (Janssen, 1987). Among other researchers, it is stated around 1.1 mmol / l (Neiman, 1986), 1-1.78 mmol / l (Mattner, 1988), and 1-1.8 mmol / l according to (Fox et al., 1993). The limit of lactic acid levels in a person's body is normally 2 mmol / l (Tanaka et al., 1983). If someone experiences an increase in lactic acid values exceeding 2 mmol / l, it will result in early signs of fatigue (Mattner, 1988). According to several researchers, giving fluids containing carbohydrates of around ± 6% during training and matches can improve athlete performance on the field by delaying fatigue due to energy that has been expended (Heather et al., 2006). Carbohydrate drinks can be given to athletes during training or recovery, or during matches (Duvillard, 2004). Giving carbohydrate drinks can not only relieve thirst but also accelerate rehydration and replenish energy in the body (Rusip, 2006).

SMA Future Gate Bekasi is one of the schools located in the middle of the Bekasi City community. SMA Future Gate has been established since 2011 until now. Activities at this school do not only involve academic abilities, but the school has facilitated activities that hone the non-academic abilities of students to develop their talents by participating in extracurricular activities at other times intracurricular activities. Narrowing down to the regulations of the Ministry of Education and Culture in 2014, it states that extracurricular activities at elementary and secondary levels in the world of education, extracurricular is one of the efforts of activities in schools in developing student character in facilitating potential, interests, talents, cooperation, and independence, in order to hone the potential, talents, interests, abilities, personality, cooperation, and independence of students

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outside of intracurricular activities. One of these activities at SMA Future Gate Bekasi which is quite successful is Futsal. Futsal games can reach 90% of maximum heart rate, so this sport can be categorized as a high intensity sport, therefore players of this sport can maximize their physical condition, tactics, and techniques to make it easier to carry out these activities (Alvarez et al., 2008). Usually futsal players spend a lot of time above 50% of playing time and enter high intensity around ± 90% of maximum heart rate, and the lactic acid value after the match reaches 5 mmol / l (Castagna et al., 2008). Fatigue is caused by excessive activity of a person, which causes the impact of lactic acid which is too high. Fatigue can interfere with and reduce a person's productivity during activities. Fatigue can be overcome by resting and the intake of carbohydrate nutrients as the main source of energy in humans. One of these studies can be done by giving carbohydrate drinks such as honey mixed with water, date palm juice mixed with water, and sports drink energy gel x by measuring blood glucose and lactic acid levels during exercise. Therefore, researchers are interested in studying the administration of honey mixed with water and sports drink energy gel x on blood glucose and lactic acid levels (SMA Future Gate Bekasi men's futsal team). The purpose of this study was to determine the significant effect of administering honey (apis mellifera Linnaeus) mixed with water, date palm juice (phoenix dactylifera) mixed with water, and sports drink energy gel x on blood glucose and lactic acid levels (SMA Future Gate Bekasi men's futsal team).

METHOD

The research design used a four-period double blind crossover design experimental method. The research group was divided into four groups that were given different treatments. Between cycles or periods are usually separated by a washout phase, which aims to eliminate residual interference from cycle to cycle (Nolan et al., 2016). The goal is to determine how much influence honey mixed with water, date palm juice mixed with water, and sports drink energy gel x have on blood glucose and lactic acid levels after futsal sports activities. The research design can be seen in the figure below.

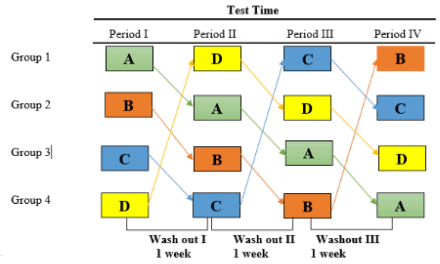

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Figure 1. Double Blind Crossover Design

Information
Treatment A: 220ml mineral water
Treatment B: Sports drink energy gel x 20ml + mineral water 200ml = 220ml
Treatment C: Honey mixed with 20ml water + 200ml mineral water = 220ml
Treatment D: Date juice mixed with 20ml water + 200ml mineral water = 220ml

The research subjects were 20 people from the total population of SMA Future Gate Bekasi students. Determination of research subjects using the purposive sampling technique. Purposive sampling technique, according to Sugiyono (2018), is sampling using several specific considerations according to the desired criteria to be able to determine the number of samples to be studied. After obtaining a total of 20 people, they will be divided into four research groups, where each group consists of 5 people. The division of groups is seen from the experience of competing in futsal so that an even distribution is obtained for each group. Where are the inclusion and exclusion criteria in determining research subjects.

Inclusion Criteria:
Willing to fill out the consent form, Physically healthy, Aged 16-19 years, Registered as a futsal extracurricular student, Have experience competing in Jabodebek

Exclusive Criteria
Sick,Diabetics/have a history of diabetes, Did not follow the research process until completion

Research Procedures

This study was conducted with a four-period double-blind crossover design with a 7-day washout period. According to (Altman & Marcussen, 2001), after period 1 ends, it will enter a phase of avoiding the influence of the previous period or commonly called the washout phase, for at least 7 days. After determining the research subjects, the researcher took anthropometric measurements and filled out a consent form to take part in a series of studies until the specified time. The measurement data and filling out the consent form were used as the initial basis for dividing the groups in the study to ensure they were balanced.

Glucose and lactic acid levels were checked four times in one group, including at 0, 20, 40, and 45 minutes. The provision of carbohydrate drinks as a treatment was divided into four groups. In the first period, group 1 was given (treatment A) honey (Apis Mellifera Linnaeus) mixed with water as much as 20 ml + 200 ml of

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mineral water that had been combined. In group 2, they were given (treatment B) date palm juice (Phoenix Dactylifera) mixed with water as much as 20 ml + 200 ml of mineral water that had been combined. In group 3, they were given (treatment C) a sport drink energy gel x as much as 20 ml + 200 ml of mineral water that had been combined. In group 4, they were given mineral water (treatment D) as much as 220 ml as a control treatment. In the next period, the research design in Figure 1 was followed with different treatments for each group and each period. The research scheme is presented in Figure 2.

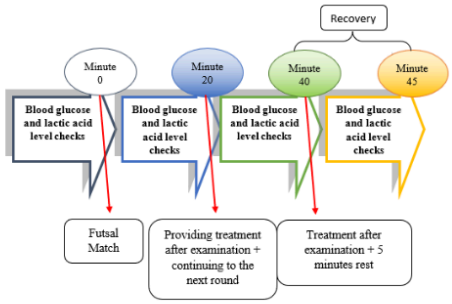

Figure 2. Research Scheme for Examination of Blood Glucose and Blood Lactic Acid Levels during Futsal Matches

The research subjects were also monitored for their pulse rate to determine the intensity of futsal sports, namely with moderate to high intensity (HR 70%-80 %). Pulse rate data were obtained from a heart rate monitor. Glucose level measurements were obtained from a glucometer (Easy Touch) by taking 0.5 ml of capillary blood using a sterile needle (lancet), lancet pen, alcohol cotton, and blood glucose strips. Lactic acid measurements were obtained from a lactate meter (Accutrend Plus) by taking 0.5 ml of capillary blood using a sterile needle (lancet), lancet pen, alcohol cotton, cotton, and Accutrend BM Lactate strips.

Table 1. Nutritional Information of Treatment Materials

Treatment Materials	Nutritional Information					
	Calories (kcal)	Total fat	Saturated fat	Protein	Total Carbohydrates	Natrium
Honey mixed with water /20,8gr/ 20ml	84 kcal	0	0	0	17	0
Dates Mixed with Water /22gr/20ml	70,1 kcal	0	0	0	17	13mg
Sport Energy Gel X/ 24gr/20ml	90 kcal	0	0	0	17	40mg

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RESULT AND DISCUSSION

Characteristics Subjects

Table 2. Research Characteristics Data

Characteristics	Total (n)	Percentage (%)
Height		
Average	169,7	
Standard Deviation	5.5	
BMI		
Underweight	0	0,0%
Normal	20	100,0%
Overweight	0	0,0%
Age		
16 Years	5	25,0%
17 Years	8	40,0%
18 Years	6	30,0%
19 Years	1	5,0%

Source: Research Data, 2023

Based on Table 2, it can be seen that the average height of students is 169.7 cm with a standard deviation of 5.5 cm. The body mass index of students is in the normal category, with a percentage of 100%, and the majority are 17 and 18 years old, with an average age of 17 years.

Blood Glucose Levels of Research Subjects

Results of the description of blood glucose levels of research subjects based on treatment groups.

Table 3. Blood Glucose Levels by Treatment Group

Blood Glucose Levels	Baseline	Minute 20	Minute 40	Minute 45
	Average ±SD	Average ±SD	Average ±SD	Average ±SD
Group I	110,0±7,5	95,2±7,8	90,8±7,8	85,2±7,4
Group II	103,1±6,6	87,5±7,4	123,6±7,0	135,5±7,7
Group III	98,1±6,6	87,4±7,0	127,3±16,4	139,4±11,5
Group IV	97,0±9,1	88,8±7,4	120,0±15,1	137,9±14,3

Source: Research Data, 2023

Blood glucose levels in the sample group given 220 ml of mineral water (group I) at the time of treatment (baseline) had an average value of 110.0 with a standard deviation of 7.5. Then in the first 20 minutes the average value decreased to 95.2 with a standard deviation of 7.8. In the 40th minute it decreased again to

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90.8 with a standard deviation of 7.8 and in the 45th minute it decreased to 85.2 with a standard deviation of 7.4.

Blood glucose levels in the sample group given sports drink energy gel X mixed with 20 ml of water + 200 ml of mineral water (group II) at the time of treatment (baseline) had an average value of 103.1 with a standard deviation of 6.6. Then, in the first 20 minutes, the average decreased to 87.5 with a standard deviation of 7.4. In minute 40, it increased again to 123.6 with a standard deviation value of 7.0, and in minute 45, it increased to 135.5 with a standard deviation value of 7.7.

Blood glucose levels in the sample group given honey mixed with 20 ml of water + 200 ml of mineral water (group III) at the time of treatment (baseline) had an average value of 98.1 and a standard deviation value of 6.6. Then in the first 20 minutes the average value decreased to an average value of 87.4 and a standard deviation value of 7.0. In minute 40, it increased again to 127.3 with a standard deviation value of 16.4 and in minute 45, it increased to 139.4 and a standard deviation value of 11.5.

Blood glucose levels in the sample group given date palm juice mixed with 20 ml of water + 200 ml of mineral water (group IV) at the time of treatment (baseline) had an average of 97.1 with a standard deviation of 9.1. Then in the first 20 minutes the average value decreased to 88.8 with a standard deviation of 7.4. In minute 40, the average value increased again to 120.0 with a standard deviation of 15.1 and in minute 45, it increased to 137.9 with a standard deviation of 14.3. If illustrated, changes in the amount of blood sugar levels can be seen during different treatments in the following graph.

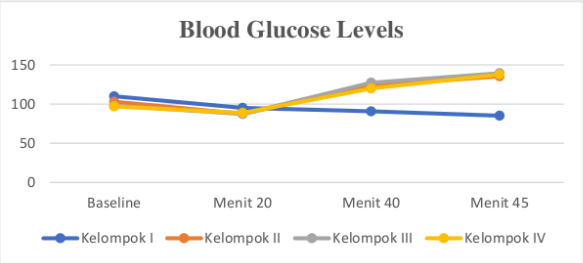

Figure 3. Baseline Blood Glucose Level Change – Minute 45

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Lactic Acid Levels of Research Subjects

Results of the description of the lactic acid levels of research subjects based on treatment groups.

Table 4. Lactic Acid Levels by Treatment Group

Lactic Acid Level	Baseline	Minute 20	Minute 40	Minute 45
	Average±SD	Average ±SD	Average ±SD	Average ±SD
Group I	1,34±0,23	6,16±1,20	7,11±1,46	5,00±0,94
Group II	1,44±0,26	6,70±0,82	4,23±1,27	3,30±0,79
Group III	1,42±0,31	6,65±1,36	5,10±1,25	4,11±1,08
Group IV	1,43±0,35	6,83±1,43	4,94±1,42	3,56±0,96

Source: Research Data, 2023

The lactic acid levels in the sample group given 220 ml of mineral water (group I) at the time of treatment (baseline) had an average value of 1.34 with a standard deviation value of 0.26. Then in the first 20 minutes the average increased to 6.16 with a standard deviation value of 1.20. In minute 40, it increased again to 7.11 with a standard deviation value of 1.46 and in minute 45, it decreased to 5.00 with a standard deviation value of 0.94. If illustrated, changes in lactic acid levels in various treatments can be seen in the following graph.

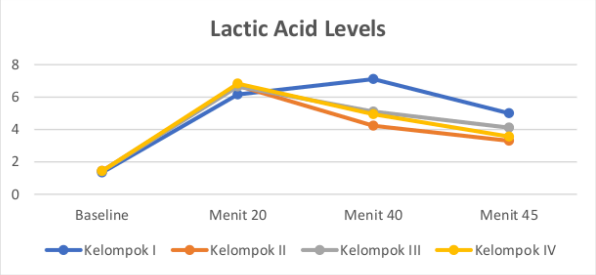

Figure 4. Baseline Lactic Acid Change – 45 Minutes

The lactic acid levels in the sample group given sports energy gel X drink mixed with 20 ml of plain water + 200 ml of mineral water (group II) during treatment (baseline) had an average value of 1.44 with a standard deviation of 0.26. Then in the first 20 minutes the average value increased to 6.70 with a standard deviation of 0.82. In minute 40, it decreased again to 4.23 with a standard deviation

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of 1.27 and in minute 45, it decreased again to 3.30 with a standard deviation of 0.79.

The lactic acid levels in the sample group given sports energy gel X drink mixed with 20 ml of plain water + 200 ml of mineral water (group III) during treatment (baseline) had an average value of 1.42 with a standard deviation of 0.31. Then in the first 20 minutes the average value increased to 6.65 with a standard deviation of 1.36. At minute 40, it decreased again to 5.10 with a standard deviation of 1.25 and at minute 45, it decreased again to 4.11 with a standard deviation of 1.08.

The lactic acid levels in the sample group given date palm juice mixed with 20 ml of water + 200 ml of mineral water (group IV) during treatment (baseline) had an average value of 1.43 with a standard deviation of 0.35. Then in the first 20 minutes it increased to 6.70 with a standard deviation of 1.43. At minute 40 it decreased again to 4.94 with a standard deviation of 1.42 and at minute 45 it decreased again to 3.56 with a standard deviation of 0.96.

Comparison Test of Blood Glucose Levels based on Treatment Groups

This calculation is used to determine the effect of treatment on blood glucose levels. The data used for the comparison test is by using blood glucose level data from minutes 20 to 45 and the difference data from blood glucose level data at minute with minutes 20 and minute 45 with minute 20. The comparison test used for this analysis is by using the General Linear Model Univariate test and the paired t-test, with the following results.

Table 5. Effect of Treatment on Blood Glucose Levels

Group	Difference Minute 40 - Minute 20 Average±SD	p-value[a]	Difference Minute 45 - Minute 20 Average±SD	p-value[a]	Effect size
I	-4,40±9,51	0,052	-10,05±9,50	0,003	
II	36,10±11,38	0,001	47,95±10,90	0,001	0,933
III	39,85±18,37	0,001	51,95±11,83	0,001	0,882
IV	31,20±17,07	0,001	49,10±15,65	0,001	0,858
p-value[b]	0,001		0,001		

Information: a = paired t-test, b=General Linear Model Univariate

Source: Output SPSS version 25.0, 2023

Two or more average data are said to have a significant difference if the probability value (p-value) is less than 0.05 and vice versa. Based on the recapitulation in table 5, it can be seen that in group II there is a significant

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difference in blood glucose levels between the 20th minute and the 40th minute and in the difference between the 20th minute and the 45th minute. This can be seen from the two probability values in group II, namely 0.001 where the value is less than 0.05 with an effect size of 93.3% in increasing blood glucose levels. The same condition can be seen from the results of the calculation of group III, there is a change in blood glucose levels with an effect size of 88.2% in increasing blood glucose levels and group IV also experienced a change in blood glucose levels with an effect size of 85.8% in increasing blood glucose levels. From these results it can be concluded that giving honey, date palm juice and sports drink energy gel X can significantly increase blood glucose levels. In other words, the three treatments have a significant effect on increasing blood glucose levels.

Comparison Test of Lactic Acid Levels Based on Treatment Groups

This calculation is used to determine the effect of treatment on lactic acid levels. The data used for the comparison test is by using lactic acid levels from the 20th minute to the 45th minute and the difference data from the lactic acid levels at the 40th minute with the 20th minute and the 45th minute with the 20th minute. The comparison test used for this analysis is by using the General Linear Model Univariate test and the paired t-test with the following results.

Table 6. Effect of Treatment on Lactic Acid Levels

Lactic Acid Level	Difference Minute 40 - Minute 20 Average±SD	p-value[a]	Difference Minute 45 - Minute 20 Average±SD	p-value[a]	Effect size
I	0,96±2,02	0,048	-1,16±1,40	0,001	
II	-2,48±1,18	0,001	-3,41±0,77	0,001	0,884
III	-1,55±1,22	0,001	-2,54±1,21	0,001	0,742
IV	-1,90±0,58	0,001	-3,28±1,03	0,001	0,881
p-value[b]	0,001		0,001		

Information: a=paired t-test, b=General Linear Model Univariate

Source: Output SPSS version 25.0, 2023

Discussion

The subjects of this study were 20 students with an average age of 17 years who can be categorized as teenagers. In this study, the subjects experienced obstacles due to inadequate nutritional intake during exercise. This finding is in accordance with several previous studies. (Purba, 2007) explained that many athletes were found to not know the amount of food that was sufficient according to the nutrition needed during training or competition, a lack of calories, an unbalanced diet, and not in accordance with the energy intake needed during the competition. In other studies, it was also the case that if the athlete's consumption

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was unbalanced and insufficient to meet their energy needs, it would affect their performance during training (Giriwijoyo & Sidik, 2012).

Another finding, namely, Heather (2006), stated that balanced nutritional intake can affect an athlete's performance during a competition. According to (Immawati, 2011) athlete performance in a competition is related to various things, namely the abilities possessed, the psychology of the athlete during the competition, namely the abilities possessed, the psychology of the athlete during the competition, the athlete's physical fitness, the training carried out before the competition and supported by carbohydrate intake during the competition and hydration status. According to Sizer (2006), one way that can be used to supply carbohydrates and reduce dehydration in athletes during training or matches is by providing drinks commonly called sports drinks.

In this study, subjects experienced a significant effect after receiving carbohydrate drink treatment on increasing glucose levels. These results are similar to previous studies where fluids containing carbohydrates during or after training can help maintain blood glucose levels and reduce the risk of fluid deficiency and hypothermia (Kalpana et al., 2011). The provision of carbohydrate drinks to research subjects can also affect the reduction in fatigue levels due to the accumulation of muscle lactic acid. These results are in line with the results of several previous studies. According to (Heather et al., 2006) the provision of carbohydrate drinks can also help reduce heart rate and fatigue levels due to the accumulation of lactic acid in the blood during competition (Rollo et al., 2009).

CONCLUSION

The conclusion of the study with a double blind cross over design with the three treatments that have been given to the subjects of this study is that consuming carbohydrate-rich drinks such as honey (apis mellifera linnaeus) mixed with water, date palm juice (phoenix dactylifera) mixed with water, and sports drink energy gel x has a significant effect on increasing blood glucose levels with each having a different percentage level with the effect size of sport drink energy gel x of 93.3%, honey mixed with water of 88.2%, and date palm juice mixed with water of 85.8%. As well as a decrease in lactic acid from the three treatments of giving carbohydrate drinks with different percentage values, namely sport drink energy gel x of 88.4%, honey mixed with water of 74.2%, date palm juice mixed with water of 88.1%. This treatment can have an effect if given during or after the match with sufficient doses.

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