

Differences in Blood Sugar Response After Giving Cane Sugar and Palm Sugar on Submaximal Physical Activity: a Literature Study

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ABSTRACT

Submaximal physical activity is an activity with heavy loads that affect the cardiovascular system, fat levels and increased muscle strength that requires a lot of energy with the aim of improving physical performance capabilities. In order for this goal to be achieved, adequate carbohydrate intake is needed before doing physical activity (pre-game meal) and one of the sources of carbohydrates that are generally used as pre-game meals is cane sugar or sucrose whose molecules consist of 50% fructose and 50% glucose. The literature search method was carried out on the Google Scholar and Survey Gate databases with the keywords "cane sugar", "palm sugar", "blood sugar" and "submaximal physical activity" limited to the last 15 years of publication. Of the 120 articles identified, 4 articles met the inclusion criteria for in-depth analysis.

INTRODUCTION

High sports achievement needs to be continuously improved. One of the factors that affects efforts to improve achievement is the physical ability of athletes, in addition to other factors such as sports facilities and infrastructure, coaching and competition systems, athletes' psychological conditions, techniques or strategies, skills or skills of athletes and the somatic state of athletes (Pasurney, 2010). Sports is a form of effort to improve the quality of Indonesian people which is directed at the formation of character and personality, high discipline and sportsmanship, as well as an increase in achievements that can arouse a sense of national pride" (Nur Madri & Zalfendi, 2018). High sports achievement needs to be continuously improved. One of the factors that affects efforts to improve achievement is the physical ability of athletes, in addition to other factors such as sports facilities and infrastructure, coaching and competition systems, athletes' psychological conditions, techniques or strategies, skills or skills of athletes and the somatic state of athletes (Pasurney, 2010). Sports is a form of effort to improve the quality of Indonesian people which is directed at the formation of character and personality, high discipline and sportsmanship, as well as an increase in achievements that can arouse a sense of national pride" (Nur Madri & Zalfendi, 2018).

Muscle endurance is also one of the things that athletes must have and of course this can only be obtained through training. The training provided by the coach to improve the endurance ability of athletes' muscles is through sub-maximum activities. Submaximal physical activity is an activity that tends to be anaerobic activity, meaning that the supply of energy takes place anaerobically or without oxygen so that it produces lactic acid, as well as can also reduce blood glucose levels. An athlete's performance at sub-maximum activity is determined by the available energy that can be used by the muscles during the activity, so the availability of energy sources needs attention. In terms of providing energy for anaerobic activities, energy can be used from intake containing fructose in addition to glucose to meet carbohydrate needs and given shortly before starting exercise. Excessive amounts of glucose are not recommended because it will cause a drastic drop in blood sugar levels due to a sudden increase in blood glucose levels. This increase in blood glucose levels will stimulate excessive insulin secretion as well, which in turn causes a drastic decrease in blood glucose levels before physical activity. To return to normal blood glucose levels before physical activity, the body compensates for it by breaking down glycogen stores that should be used during physical activity. This will cause fatigue when doing activities because glycogen stores have decreased. Fructose metabolism is not regulated by insulin. The decrease in blood glucose levels that occur during physical activity after glucose administration can be avoided by the intake of a combination of glucose and fructose before exercise (Pekik, 2007; Concha, 1997). The results of Mandosir's (2012) research showed that blood sugar loss after submaximal physical activity occurred more in the group that received a 50%:50% fructose glucose solution than in the group that received a 30%:70% fructose glucose solution. It is known

that palm sugar is a sugar that contains higher fructose than glucose and other nutrients such as potassium, iron, magnesium and antioxidants, but there is no data on how blood sugar responds after giving palm sugar at maximum physical activity. This is then the main reason for this research.

THEORETICAL REVIEW

Blood Sugar Response and Its Regulation

Blood sugar, or blood glucose, is the primary energy source for bodily functions, including physical activity. The regulation of blood sugar levels is controlled by a balance of insulin and glucagon, which ensure glucose uptake by cells and maintain stable blood glucose levels. When consuming sugar, the body breaks it down into glucose, which is absorbed into the bloodstream and used for energy. However, different types of sugar can lead to varying blood sugar responses depending on their glycemic index (GI), composition, and rate of digestion.

The Role of Carbohydrates in Physical Activity

Carbohydrates, including sugars, play a crucial role in providing energy during exercise. During submaximal physical activity—defined as moderate-intensity exercise that does not reach maximal exertion—the body primarily relies on glycogen stored in muscles and the liver. The rate of carbohydrate metabolism depends on the type of sugar consumed, with high-GI sugars providing a rapid increase in blood glucose, while low-GI sugars result in a slower and more sustained energy release.

Cane Sugar and Palm Sugar: Composition and Glycemic Index

Cane sugar, commonly known as sucrose, consists of equal parts glucose and fructose. It has a high glycemic index, meaning it is rapidly broken down into glucose and absorbed into the bloodstream, leading to a quick rise in blood sugar levels. This makes cane sugar an immediate source of energy but can also cause a rapid decline in blood sugar levels due to insulin response.

Palm sugar, derived from palm tree sap, contains sucrose along with other components such as fiber, antioxidants, and minerals like potassium and magnesium. It has a lower glycemic index compared to cane sugar, leading to a slower rise in blood sugar. This slower absorption provides a more sustained energy release, which may be beneficial for maintaining endurance during submaximal physical activity.

Blood Sugar Response to Sugar Consumption Before and During Exercise

The timing and type of sugar consumed before or during submaximal exercise can influence performance and endurance. High-GI sugars, like cane sugar, provide an immediate energy boost but may lead to an energy crash due to a sharp insulin response. Low-GI sugars, such as palm sugar, offer a steadier energy release, potentially preventing fatigue during prolonged activity. Studies comparing these sugars suggest that athletes and physically active

individuals may benefit from selecting a sugar type that aligns with their performance needs and exercise duration.

Implications for Athletic Performance and Health

The choice between cane sugar and palm sugar can impact both athletic performance and metabolic health. Frequent consumption of high-GI sugars can contribute to insulin resistance and metabolic disorders, while lower-GI alternatives may help maintain stable blood sugar levels and reduce the risk of energy crashes. Future research should focus on long-term effects of different sugar types on endurance, recovery, and overall metabolic health in individuals engaging in submaximal physical activity.

METHODOLOGY

This study uses the narrative review approach as a secondary research method to assess the potential of palm sugar. Data collection was carried out through a literature search from electronic sources, namely Google Scholar using the keywords "granulated sugar", "palm sugar", "blood sugar" and "submaximal physical activity". The inclusion criteria used are original research articles published in the last 15 years. The feasibility of an article is assessed based on the reputation and credibility of the journal publisher to ensure the quality and relevance of the data used. The collected data was then extracted and summarized systematically to obtain a comprehensive picture of the potential of palm sugar as an energy source in submaximal activities.

RESULTS AND DISCUSSION

	Researcher/Year	Research Title	Research Results
1	Dwi Riah Hofifah, dkk/ 2022	The Relationship of Physical Activity to Blood Sugar Levels in the Elderly at the 2022 UPTD Tresna Werdha Social Home Pagar Dewa Bengkulu.	Thereis a real relationship between physical activity and blood sugar levels.
2	Mandosir/2012	Effect of Combination of Glucose: Fructose 30%: 70% Compared With Combination Glucose: Fructose 50%: 50% of Blood Glucose and Blood Lactic Acid Before and After Sub-maximal Physical Activity	There was a difference in blood sugar response between the administration of a 50%:50% fructose glucose solution and a 30%:70% fructose solution, where blood sugar loss after sub maximal physical activity occurred more in the group that received a 50%: 50% fructose glucose solution compared to the group that received a 30%:70% fructose glucose solution.

3	Nur Fadhillah/ 2010	Effect of Consumption of Granulated Sugar and Palm Sugar on Blood Sugar Levels in Diabetic Patients with Millitus in Bulokarto Village, Gadingrejo District, Pringsewu Regency in 2010.	The average distribution of changes in sugar content in the palm sugar group was 25.56 mg/dl. Meanwhile, the change in blood sugar levels in the sugar group was obtained on average 45.80 mg/dl. Thus, it can be concluded that there is a significant difference in the difference in sugar content increase between the consumption of granulated sugar and palm sugar to blood sugar levels in people with diabetes mellitus.
4	M. Akil/2023	Effect of Palm Sugar (Arenga Pinnata) on Active Recovery on Submaximal Physical Activity of Porprov Pencak Silat Athletes in Luwu Regency	The administration of palm sugar has an effect or results in active recovery in the submaximal physical activity of porprov pencak athletes in Luwu Regency.

Based on the description of the table above, research on blood sugar response before and after maximum physical activity in the administration of cane sugar solution and palm sugar solution shows that there is an increase in blood sugar before submaximal physical activity but also a decrease in blood sugar after submaximal physical activity, although the literature review shows that there is a more specific difference in blood sugar response, Where in the administration of granulated sugar, it will increase blood sugar more before submaximal physical activity and the decrease in blood sugar after submaximal physical activity will occur less in the administration of palm sugar.

Another study conducted by Dwi Riah Hofifah, et al. (2022) with a study of the impact of physical activity on lowering blood sugar in the elderly at the UPTD Tresna Werdha Pagar Dewa Bengkulu Social Home proved that physical activity can have a significant blood sugar lowering effect. In theory, it is explained that after exercise blood sugar levels will be lower or decrease compared to blood sugar levels under normal conditions, this is because sugar or glucose is used as fuel during exercise. Clark (2001) mentioned that carbohydrates are the main source of calories as muscle fuel, especially when doing exercises. According to Richter in Neldi (2001), with physical exercise, the decrease in blood glucose levels will increase because the translocation of GLUT-4 will increase with mechanisms through increased epinephrine secretion,

increased calcium ions, increased metabolic stress, and increased insulin delivery so that glucose uptake from the blood increases and blood glucose levels will decrease even more.

Regarding the use of granulated sugar and palm sugar as an energy source in submaximal physical activity, it is known that granulated sugar contains sucrose, while palm sugar contains more fructose content than glucose. It was again explained that the decrease in blood glucose levels that occur during physical activity after glucose administration can be avoided with the intake of a combination of glucose and fructose before exercise (Pekik, 2007; Concha, 1997), here proves that fructose has a good role in maintaining stable blood glucose levels even after carrying out physical activity. Research conducted by Mandosir (2021) showed that there was a difference in blood sugar response between the administration of a 50%:50% fructose glucose solution and a 30%:70% fructose solution, where blood sugar loss after submaximal physical activity occurred more in the group that received a 50%:50% fructose glucose solution compared to the group that received a 30%:70% fructose glucose solution. The results of Mandosir's (2012) research above are in line with Nur Fadhilah's (2010) research, with the subject of the study being diabetic mellitus patients who receive granulated sugar and palm sugar. The results showed that there was a significant difference in the increase in sugar content between the consumption of granulated sugar and palm sugar to blood sugar levels in people with diabetes mellitus.

Another study conducted by M. Akil (2023) shows that giving palm sugar before submaximal physical activity shows a better active recovery. The recovery indicator in M. Akil's research is a faster decrease in exercise pulse. The exercise pulse of people who are active in exercising recovers faster than people who rarely exercise, in addition to the decrease in blood sugar is also less. The difference in blood sugar levels after administration of granulated sugar containing sucrose and palm sugar after submaximal physical activity is related to the chemical composition and the way the body processes these two types of sugar, which can be explained as follows:

Granulated sugar or sucrose

Composition: Sucrose is a disaccharide made up of glucose and fructose. When it enters the body, sucrose is broken down into glucose and fructose by enzymes in the digestive tract. **Absorption:** The glucose formed from sucrose is absorbed rapidly into the bloodstream, increasing blood sugar levels rapidly. This leads to a faster spike in blood sugar after consumption. **After Physical Activity:** After submaximal physical activity, the body needs the recovery of glycogen and blood sugar. Consumption of granulated sugar can speed up recovery because it is quickly absorbed and provides a source of glucose that is immediately available to the body.

Palm sugar

Composition: Palm sugar comes from coconut sap and contains sucrose, glucose, and fructose. However, palm sugar usually has a higher content of minerals and bioactive compounds such as potassium and magnesium compared

to granulated sugar. Absorption: Palm sugar has a lower glycemic content compared to granulated sugar, meaning that palm sugar raises blood sugar levels more slowly and more steadily. This is due to the more diverse composition of sugars and the content of additional nutrients that can affect the rate of glucose absorption. After Physical Activity: After physical activity, palm sugar can provide more stable energy due to the slower release of glucose. This can help avoid rapid spikes in blood sugar, which can be followed by a sharp drop in blood sugar levels.

Comparison of Blood Sugar Levels

Sugar, tends to cause a faster spike in blood sugar levels after consumption. This can be useful for quick recovery after intensive physical activity, but it can lead to greater fluctuations in blood sugar levels whereas palm sugar, increases blood sugar levels more slowly and provides more stable energy. It may be more beneficial in maintaining long-term blood sugar balance after submaximal physical activity.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the study that has been carried out, it is concluded that granulated sugar tends to increase blood sugar faster and sharply before physical activity and experiences a drastic decrease after physical activity, while palm sugar provides a slower and more stable increase in blood sugar before physical activity and experiences a slow decrease after physical activity, So it is more suitable to avoid extreme fluctuations in blood sugar when doing physical activity.

FURTHER STUDY

Based on previous studies, very few studies have discussed the differences in blood glucose response from different sugar sources, namely; Monosaccharides, disaccharides and polysaccharides are mainly related to pregame meals. In general, athletes and coaches use sugar water (sucrose) which has a glucose:fructose composition of 50%:50% as a supplement drink for exercise and sports to obtain energy (Fox, 1993). To produce pregame meals that suit the needs and conditions of athletes, it is necessary to conduct a more in-depth and comprehensive study of natural energy sources both in vitro and in vivo.

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