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The effect of blood glucose, blood lactate and creatine kinase levels after carbohydrate-protein supplement uptake on recovery period after exercise in pencak silat athletes

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Abstract

Pencak Silat, a traditional martial art from Southeast Asia, has gained recent popularity, prompting interest in performance enhancement methods. Therefore, The purpose of this study to examine the effects of carbohydrate-protein supplementation on blood glucose, blood lactate and creatine kinase levels at the period of recovery after exercise in Pencak Silat Athletes. Mate-rials and Methods: Thirty elite athletes (average age 18-25 years) participated, divided into three groups, each undergoing a 90-minute cycling session at 75% VO_2 max. Participants con-sumed CHO-PROT, carbohydrate (CHO), or placebo (PLA) drinks 15 minutes before and 45 minutes after exercise. Blood samples were collected before, during, and after exercise. Results: indicated that CHO-PROT and CHO groups exhibited significantly higher blood glucose levels compared to the PLA group ($p<0.05$), particularly around 75 minutes and 1.5 hours post-exercise. Blood lactate levels did not significantly differ among groups post-exercise. Notably, CHO-PROT consumption led to lower creatine kinase levels compared to CHO and PLA groups ($p<0.05$), suggesting reduced muscle damage. CHO consumption also demonstrated lower crea-tine kinase levels compared to the PLA group ($p<0.05$). Conclusions: CHO-PROT supplementa-tion can elevate blood glucose during post-exercise recovery without influencing blood lactate, highlighting its potential benefits for Pencak Silat athletes.

Keywords: *Carbohydrate-Protein Supplement ; Pencak Silat Athletes ; Recovery Period*

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INTRODUCTION

Pencak Silat, a traditional martial art from Southeast Asia, relies on explosive movements, endurance, and strength. Athletes use nutritional strategies and supplements, particularly carbohydrate-protein supplements, to enhance performance and recovery (Alghannam et al.,2020). This essay explores the impact of these supplements on blood glucose, blood lactate, and creatine kinase levels in Pencak Silat athletes. Pencak Silat combines physical prowess, agility, and combat techniques, requiring a delicate metabolic balance during training and competition. Nutritional interventions for post-exercise recovery, focusing on blood glucose, blood lactate, and creatine kinase levels, have gained attention in sports science. Carbohydrate-protein supplements show promise in improving recovery for Pencak Silat athletes (Kloby Nielsen et al.,2022). Pencak Silat athletes engage in high intensity training regimens, often involving anaerobic bursts and vigorous physical exertion. Such activities elicit a surge in blood lactate levels, reflecting the reliance on glycolytic pathways to meet energy demands. Concurrently, skeletal muscle damage during strenuous exercise can elevate creatine kinase levels, indicative of muscle fiber disruption (Karp et al.,2019). The immediate post-exercise phase marks a critical window for the restoration of physiological equilibrium, wherein efficient clearance of lactate and replenishment of energy stores are imperative. Carbohydrate-protein supplementation has emerged as a strategic approach to expedite these processes, as carbohydrates facilitate rapid glycogen resynthesis, while protein supports tissue repair and adaptation. Notably, blood glucose fluctuations, coupled with lactate dynamics and creatine kinase kinetics, play a pivotal role in dictating the body's readiness for subsequent training bouts or competitive engagements (Smith et al.,2021). training strategies but also for promoting the overall well-being and performance of athletes practicing this intricate martial art form (Johnson et al.,2021; Suwirman et al.,2021). This study aimed to examine the effects of carbohydrate-protein supplementation on blood glucose, blood lactate and creatine kinase levels at the period of recovery after exercise in Pencak Silat Athletes.

METHOD

The research method used was a randomized to receive beverages before and after the experiment. This experiment employed a Randomized, double-blind, crossover design, with three types of beverages: Carbohydrate-Protein drink (CHO-PROT), Carbohydrate drink (CHO), and Placebo drink (PLA) (Table 1), based on the study by Greer et al., 2014. Each experimental session had an equal number of sample groups. In each session, the sample group received different beverages and was unaware of the type of beverage they received. sample received the beverages twice, 15 minutes before exercising and at the 30 minute mark of the exercise session. The sampling protocol used Participants was 30 Men Pencak silat players Thailand National Sports University, Yala campus, aged 18-25 years old. There were 3 experimental groups that each group had a recovery period at least 2 weeks. In each experiment participants were cycling at 75 percent of maximum oxygen consumption for 90 minutes. All participants received three different types of drinks, i.e., carbohydrate-protein (CHO-PROT), carbohydrate (CHO) and placebo (PLA) at the period of 15 minutes before exercise and 45 minutes after exercise. Blood samples were taken at 15, 30, 75 minutes before exercise and 1, 10, 20, 30 minutes and 24 hours after exercise. Ethical approval was obtained by the Institute Ethics Review Committee for Research Involving Human Project, Thailand The research project was approved by the Research Ethics Committee of the Institutional Review Board for Human Subjects Research at Sirindhorn College of Public Health in Yala, Thailand, and was assigned certificate number SCPHYLIRB-2023/104.

Table 1. Components of each beverage

Component	CHO-PROT	CHO	PLA
Glucose (g)	40	50	-
Branched-chain amino acids (g)			
Isoleucine	2	-	-
Leucine	5	-	-
Valine	3	-	-
Sodium chloride (mg)	50	50	50
Artificial sugar (g)	4	-	4
Lemon flavoring agent (ml)	2	2	2
Water volume (ml)	848	848	848
Amount of drink per drink (ml)	424	424	424
Energy (calories)	200	200	-
Osmolality (mOsm/kg)	315	300	294

Subjects were randomly assigned 10 drinks per group, with different drinks given to them without knowing which drink they received. The study aimed to understand the effects of different drink groups on participants' beverage intake, shown in Table 2

Table 2. Grouping of Beverage Acquisitions

Sample (person)	Experiment 1	Experiment 2	Experiment 3
10	CHO-PROT	CHO	PLA
10	PLA	CHO-PROT	CHO
10	CHO	PLA	CHO-PROT

The test to determine the maximum oxygen consumption capacity (VO_2max) was conducted using a Monark 828E exercise bicycle and a gas analyzer (Cortex; Metamax 3B). The maximum achievable workload was identified following the protocol established by Per-Olof Astrand, as referenced from Schantz et al., 2022. The researchers calculated the individual's maximum cycling capacity and then derived 75% of their VO2max to set the experimental intensity. Participants in the research project refrained from engaging in strenuous physical activities for 72 hours and abstained from consuming alcoholic beverages and caffeinated drinks, such as tea, coffee, and carbonated beverages. Except for plain water, which was allowed up to 10 hours prior to the start of the experiment**.**

The Sample size for crossover design According to Wych et al. (2019), the mean change in creatine kinase (U/L) before and after the experiment was 138.43 and 188.29, respectively, and the standard deviation (S.D.) before and after the experiment was 38.59 and 71.95, respectively. The sample size calculation is as follows formula:

$$n = \left((Z_{\alpha/2} + Z_{\beta})^2 \delta \right) / \triangle^2 \quad (1)$$

Assign to $\alpha = 0.05$ $Z_{\alpha} = Z_{0.05/2} = 1.96$ (two tail)

$\beta = 0.10$ $Z_{\beta} = Z_{0.10} = 1.28$

$$\delta = (SD_1)^2 + (SD_2)^2$$

$$\delta = (38.59)^2 + (71.95)^2 = 6665.99$$

$$\triangle = (\overline{X}_1 - \overline{X}_2)$$

$$\triangle^2 = (138.43 - 188.29)^2 = 2486.02$$

From the formula $n = ((Z_{\alpha/2} + Z_{\beta})^2 \delta) / \triangle$ (2)

Substitute for n = (1.96 + 1.28) 2 6665.99/2486.02=28.015 About 29 people

Therefore, this study used a sample of 30 people. This research used a total sample of 30 people. The data were analyzed using the following steps for this research, Data analysis was conducted for the research project. In this section, basic statistical objectives, including the mean and standard deviation (S.D.), were analyzed to examine the variability. A two-way repeated measurement experimental design was used to analyze the pattern of variation in blood sugar levels, blood exchange levels, and creatinine levels. The differences were pairwise compared using the Tukey method to determine statistically significant differences at the 0.05 significance level.

RESULTS

The results showed: Blood glucose level in CHO-PROT and CHO groups were significantly more than in PLA group (p<.05). At the period around 75 minutes and 1, 30 minutes after exercise were significant differences (p<.05). Blood lactate levels were no significant difference after exercise among 3 groups. However, Creatine kinase level in CHO-PROT group was significant different less than CHO and PLA groups after exercise (p<.05). In addition, Creatine kinase level in CHO group was significant difference less than the PLA group after exercise (p<.05) at the period of 1, 30 minutes and 24 hours after exercise. they are shown in Figure 1.

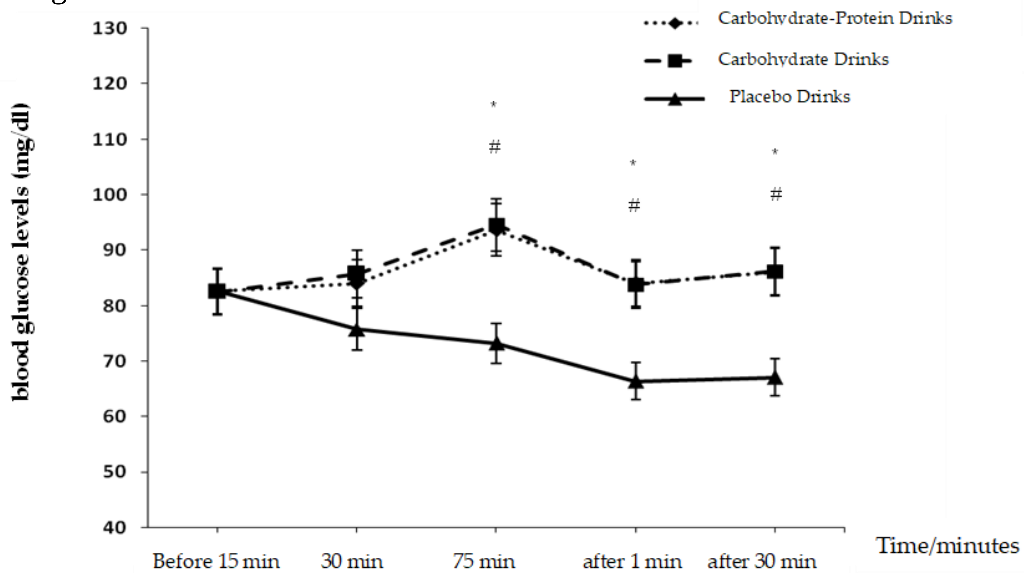

Figure 1. The difference in blood glucose levels (milligrams/decilitre) among Pancak Silat athletes who consumed carbohydrate-protein beverages, carbohydrate beverages, and placebo beverages

* = Pancake Silat athletes who receive carbohydrate-protein drinks and Pancake Silat athletes, unlike the group of Pancake Silat athletes who received the placebo drinks, were statistically significant at the 0.05 level.
# = Pancak Silat athletes who receive carbohydrate drinks different from Pancak Silat athletes received a statistically significant placebo drink at the 0.05 level.

In this experiment, it was found that blood sugar levels before exercise were the same in all 3 groups of Pancak Silat athletes. There was no difference (Figure 1), however, when comparing the Pancak Silat athletes. It was found that blood sugar levels were higher among Pancak Silat athletes who received carbohydrate-protein drinks than among Pancak Silat athletes who received carbohydrate drinks. There was a statistically significant difference (p 0.05) at the 75^{th} minute of exercise and the 1^{st} and 30^{th} minutes after the exercise.

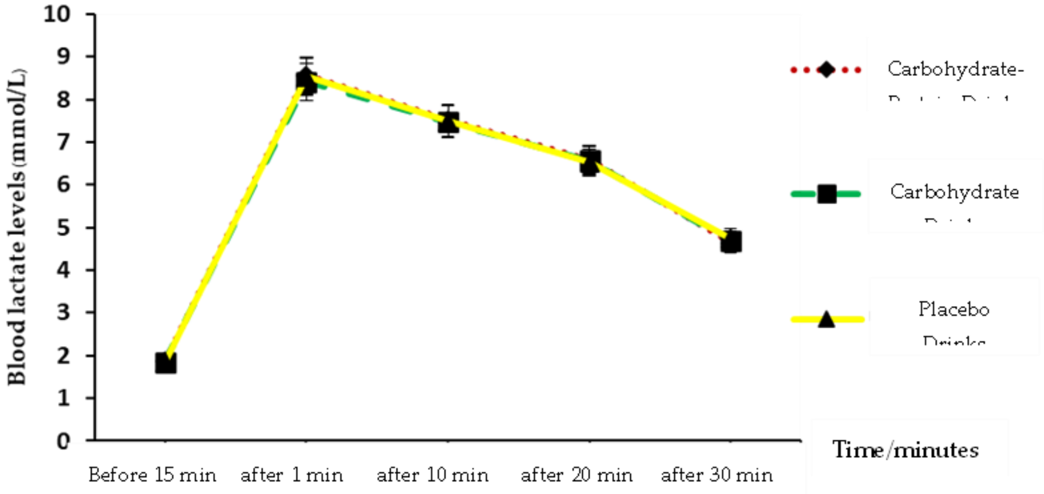

Figure 2. The difference in blood lactate levels (mmol/L) among Pancak Silat athletes who received Carbohydrate-Protein drinks Carbohydrate drinks and placebo drinks

The results of this experiment revealed that the pre-exercise blood lactate levels were consistent across all three groups of Pancak Silat athletes. No significant variations were observed in blood lactate levels among the three groups. However, there was a notable statistical discrepancy in blood lactate levels after the first minute of exercise compared to the levels 15 minutes prior to exercise. Furthermore, these levels demon-strated a decreasing trend in subsequent exercise minutes, specifically at the 10th, 20th, and 30th minute marks after exercise ($p < 0.05$). Upon examining the impact of differ-ent beverage types on blood lactate levels, it was evident that the beverages consumed by the three groups of Pancak Silat athletes, namely carbohydrate-protein drinks (CHO-PROT), carbohydrate-only drinks (CHO carb), and placebo drinks (PLA), had an influence on lactate levels. However, statistical analysis indicated that the differences were not significant. Similar findings were obtained when considering various time intervals: 15 minutes prior to exercise, after the first minute of exercise, after the 10th minute of exercise, after the 20th minute of exercise, and after the 30th minute of exercise. The exposure to different beverages resulted in a statistically significant difference of 0.01 in blood lactate levels. Further post hoc analysis using Tukey's method re-vealed that significant differences existed in blood lactate levels. Specifically, there were significant differences between the lactate levels at the 15 minute pre-exercise interval and those after the 1st, 10th, 20th, and 30th minutes of exercise. Moreover, differences were observed between the lactate levels after the 1st and 10th minutes of ex-ercise, after the 1st and 20th minutes of exercise, after the 1st and 30th minutes of exercise, after the 10th and 20th minutes of exercise, after the 10th and 30th minutes of exercise, and after the 20th and 30th minutes of exercise. All of these significant differences were determined at a 0.05 level of statistical significance.

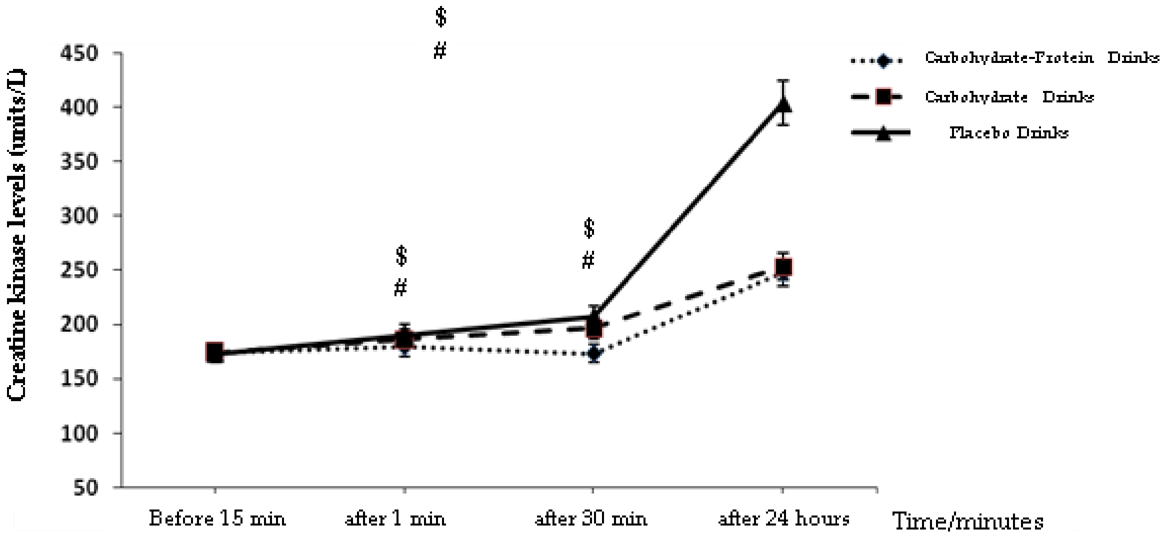

Figure 3. The difference in creatine kinase levels (units/L) among the Pancak Silat athletes who received a carbohydrate-protein drink Carbohydrate drinks and placebo drinks

$ = A carbohydrate-protein drink was administered to a group of Pancak Silat athletes, distinguishing them from another group of Pancak Silat athletes who were given a carbohydrate drink, as well as from a separate group who received a placebo drink. The observed difference between these groups was statistically significant at the 0.05 level.

= Pancak Silat athletes who were provided with carbohydrate drinks exhibited a notable contrast when compared to Pancak Silat athletes who were administered a placebo drink, demonstrating statistical significance at the 0.05 level.

In the conducted experiment, it was observed that creatine kinase levels had become elevated before the commencement of exercise across all three groups of Pancak Silat athletes. However, when the Pancak Silat athletes were compared, no distinctions were discernible (Figure 3). Subsequently, it was determined that creatine kinase levels had risen among a group of Pancak Silat athletes who were administered a carbohydrate-protein drink. A statistically significant variance ($p < 0.05$) emerged between the Pancak Silat athletes who consumed a carbohydrate drink and those who received a decogie drink. Notably, the creatine kinase levels were lower in the group of Pancak Silat athletes who were provided with a placebo drink. This disparity yielded a statistically significant divergence ($p < 0.05$) when juxtaposed with the Pancak Silat athlete group. Moreover, a statistically significant difference in creatine kinase levels materialized following 24 hours of exercise in comparison to the levels recorded 15 minutes prior to exercise onset at minute 1 and minute 30 of exercise ($p < 0.05$).

The results of the experiment indicated that creatine kinase levels before exercise were observed in all three groups of Pancak Silat athletes. However, upon comparing the Pancak Silat athletes who received Carbohydrate-Protein Drink with the group that received a carbohydrate drink, a significant decrease in creatine kinase levels was noted. A statistically significant disparity was evident between the group of Pancak Silat athletes who received a carbohydrate drink and the group that received a placebo drink ($p < 0.05$). Furthermore, Pancak Silat athletes who were administered carbohydrate drinks displayed lower creatine kinase levels than those who were given placebo drinks. Significant differences were also observed when analyzing creatine kinase levels within the Pancak Silat athletes ($p < 0.05$). The highest increase in creatine kinase levels occurred after the exercise. In relation to blood sugar levels, the experiment demonstrated that before exercise, there were similar levels among all three groups of Pancak Silat athletes. Nevertheless, upon comparing the group of Pancak Silat athletes who received carbohydrate-protein drinks with those who received carbohydrate drinks, a statistically significant difference emerged at the 75-minute exercise interval, as well as at 1 and 30 minutes after the workout ($p < 0.05$). The results indicated that blood glucose levels in the CHO-PROT and CHO groups were significantly higher than in the PLA group, particularly around the 75-minute and 1, 30-minute marks after exercise. Blood lactate levels did not exhibit any significant differences among the three groups after exercise. However, post-exercise, the Creatine kinase level in the CHO-PROT group showed a significant decrease compared to the CHO and PLA groups ($p < 0.05$). Additionally, the CHO group displayed a significant reduction in Creatine kinase levels compared to the PLA group ($p < 0.05$) at the 1, 30-minute, and 24 hour marks post-exercise. In conclusion, the experiment showed that the consumption of CHO-PROT drinks to enhance blood glucose levels during the recovery period following exercise did not have an impact on blood lactate levels (Oosthuyse et al.,2021; Sollie et al.,2021). However, the data suggested that CHO-PROT supplementation resulted in a reduction of creatine kinase levels, thereby potentially mitigating muscle damage during the recovery phase after exercise (Sollie et al.,2021; Margolis et al.,2021). This study aims to investigate the dynamic relationships between blood glucose carbohydrates (Xu et al., 2020;

Dahl et al., 2020)., blood lactate, and creatine kinase concentrations following the uptake of a carbohydrate-protein supplement and their subsequent influence on the recovery period after exercise bouts in Pencak Silat athletes.

Carbohydrates as an Energy Source Carbohydrates serve as a primary energy source for the body. During exercise, body cells efficiently metabolize carbohydrates (Bennett et al., 2020; Suzuki et al., 2020). Stored in the muscles and liver as glycogen, carbohydrates undergo breakdown into glucose by these tissues. This glucose is then utilized as energy, adapting to the body's energy requirements (Namma-Motonaga et al.,2021; Yiheng Liang et al.,2021). Carbohydrate Drinks for Athletes, Athletes can benefit from carbohydrate drinks containing 6-8% carbohydrates (referred to as isotonic drinks). These beverages prove suitable as they replenish glycogen stores, ensuring a sustained exercise performance by providing energy to muscles. It's recommended that athletes consume 30-60 g of carbohydrate drinks every 15-20 minutes during exercise (Naclerio et al., 2019; Olsen et al., 2010; Liang et al., 2022). This regimen helps to maintain optimal energy levels and offset mineral loss Proteins for Energy and Recovery, While carbohydrates take the lead in energy provision, proteins play a role as intermediaries in energy production pathways (Hansen et al.,2020; Goldstein et al.,2022). Among amino acids, branched-chain amino acids (BCAAs) such as isoleucine, leucine, and valine contribute significantly to energy generation. Not only do BCAAs potentially curtail muscle breakdown and the risk of injuries, but they also enhance endurance and facilitate muscle recovery (Mertz et al.,2021; Ten Haaf et al.,2021). Protein Drinks and Endurance Athletes engaged in high-intensity and endurance training may choose to incorporate protein drinks into their regimen to enhance performance An intake of up to 10-20 grams of protein per hour can prove beneficial (Larsen et al.,2019; Ozan et al.,2020).

Consuming protein during a marathon, for instance, can elevate protein concentration in the bloodstream, contributing to the supply of muscle energy and mitigating muscle breakdown Benefits of Carbohydrate-Protein Drinks In the realm of sporting events, carbohydrate or protein drinks are employed prior to and between competitions to augment exercise efficiency endurance (Ruan et al., 2021; Kontro et al., 2020), and recovery. These beverages play a role in minimizing muscle injuries, curtailing lactate accumulation, and overall performance enhancement (Nhung & Khanh, 2023; Viribay et al., 2020). Carbohydrate-protein supplements hold promise as a nutritional strategy to influence blood glucose, blood lactate, and creatine kinase levels during the post-exercise recovery phase in Pencak Silat athletes. The combination of fast-absorbing carbohydrates and muscle-supporting proteins offers a promising way to expedite energy replenishment, accelerate lactate clearance, and reduce muscle damage (Rodrigo Abreu et al.,2023; Churchward-Venne et al.,2020; Moreno-Pérez et al.,2023).

The discussion of this presents significant findings related to the impact of carbohydrate-protein drinks, carbohydrate drinks, and a placebo on Pancak Silat athletes. The study revealed that after exercise, athletes who consumed carbohydrate-protein drinks and carbohydrate drinks experienced higher blood sugar levels compared to those who consumed a placebo. This increase in blood sugar was observed at various time points during and after exercise, indicating the role of carbohydrates and branched-chain amino acids in providing energy. Additionally, the study found elevated creatine kinase levels before exercise in all athlete groups. Notably, Pancak Silat athletes who consumed carbohydrate-protein drinks had lower creatine kinase levels compared to those who had carbohydrate drinks, suggesting a potential protective effect on muscle damage during the recovery phase. While blood sugar levels were consistent before exercise across all groups, significant differences were noted between the Carbohydrate-Protein (CHO-PROT) and Carbohydrate (CHO) groups when compared to the placebo (PLA) group. Blood lactate levels showed no significant differences among the athlete groups after exercise. These findings indicate that supplementation with Carbohydrate-Protein Drinks (CHO-PROT) during the recovery phase may be beneficial in reducing creatine kinase levels and potentially minimizing muscle damage post-exercise.

CONCLUSION

The purpose of this study is to examine the effects of carbohydrate-protein supplementation on blood glucose, blood lactate, and creatine kinase levels during the period of recovery after exercise in Pencak Silat. In conclusion, the experiment showed that CHO-PROT supplementation resulted in increased blood glucose levels during the recovery period after exercise without affecting blood lactate levels. Furthermore, the data suggested that CHO-PROT supplementation was associated with a reduction in creatine kinase levels, indicating a potential benefit in minimizing muscle damage during the recovery phase after exercise. This suggests that CHO-PROT drinks could play a role in aiding athlete recovery and potentially enhancing overall performance.

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