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ABSTRACT

A sports drink is a drink containing electrolytes and glucose, meanwhile coconut drink is known as a natural source of sports drink. Both drinks have the benefit of restoring energy and electrolyte, especially when ingested during strenuous physical activity that requires maximum endurance performance. The purpose of this study was to compare the effects of sports drinks and coconut drinks in enhancing cardiovascular endurance performance among UiTM football players. A total of 24 male participants representing Universiti Teknologi MARA Football Club (UiTM FC) were recruited. Participants were randomly assigned into three groups that are isotonic drink group (IDG) (n=8), the coconut drink group (CDG) (n=8), and the control group (n=8). Cardiovascular endurance performance was determined based on bleep test results at the pre-test and post-test. The intervention was conducted by giving a different type of drink according to the assigned group. IDG received 100 plus isotonic drink, CDG received a Vita Coco drink and CG were only given plain water. After the end of the pre-test session, the participants were given 2-hour to rest, and drinks were given according to their group. After 2-hour of rest, the participants continue with the post-test. The level of VO2 max was measured by an equation based on the bleep test results. The result shows there was a significant increment in pre-post-test VO2 max level within all groups, showing improvement in the mean level of VO2 max at post-test. The mean of pre-post-test VO2 max for the three respective groups was IDG 47.53 ± 6.32 to 49.46 ± 5.88 ml/kg/min, CDG 47.01 ± 3.45 to 48.81 ± 3.29 ml/kg/min and CG 47.06 ± 3.11 to 47.91 ± 3.43 ml/kg/min. However, there was no significant difference (p=0.276) between groups and pre-post-test VO2 max level. Looking at between groups effect, there was no significant effect (p=0.900) between these three groups and their VO2 max level. In conclusion, there was a significant positive change in the participant's pre-post-test VO2 max level for all three groups across two different periods at the pre-test and post-test. This suggests ingesting drinks between exercises substantially improved football players' cardiovascular endurance performance. However, there was no significant difference in the participants' cardiovascular endurance performance between the three groups. This indicates the type of drink does not influence the cardiovascular endurance performance among these football players.

***Keywords**: Sports drink, coconut drink, endurance performance, football players*

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INTRODUCTION

Endurance exercise is part of the cardiovascular system that involves the heart, lung, and blood vessels and the athletes' aerobic capacity might affect their endurance performance (Nystoriak & Bhatnagar, 2018). Football matches involved the combination of endurance capacity, repeated high-intensity running, and numerous sprints in between the 90-minute game with aerobic-type recovery actions (Stølen et al., 2005). During high-intensity exercise or any sports event, athletes lose water and electrolyte by sweat and consume a lot of energy, and the loss of even 2% of liquid as a result of training or mild dehydration may cause a significant decrease in their performance (Colakoglu et al., 2016). Losses of fluid over 2.5% of body weight can decrease the capacity for high-intensity work by about 15% for exercise lasting 7 minutes (Ismail et al., 2007).

Ingestion of a sports drink was proved to be helpful for adult athletes who practice intensive exercises for long periods, with high intensity, in the heat environment, or at high humidity (Simulescu et al., 2019). Sports drink is a drink that contains electrolytes such as sodium, potassium, chloride, and sugar (Simulescu et al., 2019). It was designed to restore energy for the active person who is doing the exercise whether during or after sporting activity or strenuous exercise. Sports drink is beneficial to our body because when we lose the electrolytes it helps to restore the energy and rehydration of the athletes after training or competition by replenishing carbohydrates, electrolytes, and other nutrients which can delay the onset of fatigue. Varying carbohydrate content, osmolality, electrolyte content, flavoring, and the inclusion of other nutrients, has resulted in the creation of three sports drink types isotonic, hypotonic, and hypertonic (Hornsby, 2011; Rowlands et al., 2022). Between these three types, isotonic is the most used during sports activity at high intensity that is 60 minutes or more, because the consumption of isotonic drink have similar effect on the electrolytes level in the blood. (Demirhan et al., 2015).

Over the last few years, coconut water has been introduced as a natural sports drink and is viewed as the hydrating beverage of choice in a certain part of the world. Coconut waters are very rich in potassium, contain sodium chloride and carbohydrate (Chaubey et al., 2017). In relation to sports nutrition, coconut water has been reported as a drink that provides hydrating effects similar to those of carbohydrate-electrolyte sports drinks (Kreider et al., 2010). Between isotonic drinks and coconut drinks, there are differences in the content of potassium and sodium. Isotonic drinks mostly contain a large amount of potassium together with other electrolytes, often in a similar concentration to the estimated presence in the sweat. Meanwhile, coconut drink has low sodium and high potassium content, and it has been shown to have a relatively low rehydration index (Campbell-Falck. D et al., 2000).

From the previous literature, there was a relationship between cardiovascular endurance performance and the ingestion of sports drinks as a fluid replacement during exercise. Sports drinks help the body by supplying exogenous fuel of carbohydrate as well as helps maintain plasma volume and prevents dehydration (Colakoglu et al., 2016). Studies show that ingestion of sports drinks during exercise in hot and humid environments can help prevent dehydration, muscle strain, and it also can improve endurance exercise capacity (Burdon et al., 2012; González-Alonso et al., 1992), and so does the coconut drinks that give a significant effect on performance same as the sports drinks (Chuku L. C. & Kalagbor G. I, 2014; Ismail et al., 2007; Saat et al., 2002). Findings from previous studies reported both drinks to have the benefit of restoring energy and electrolyte, especially when ingested during strenuous physical activity

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that requires maximum endurance performance. Thus, the purpose of this study was to compare the effects of sports drinks and coconut drinks in enhancing cardiovascular endurance performance among UiTM football players.

METHODOLOGY

Research design

The true experimental design was used in this study with the administration of pre-test and post-test. Participants were randomly assigned and divided into three groups as shown in Figure.1: (i) isotonic drink group (IDG), (ii) coconut drink group (CDG), and (iii) control group (CG).

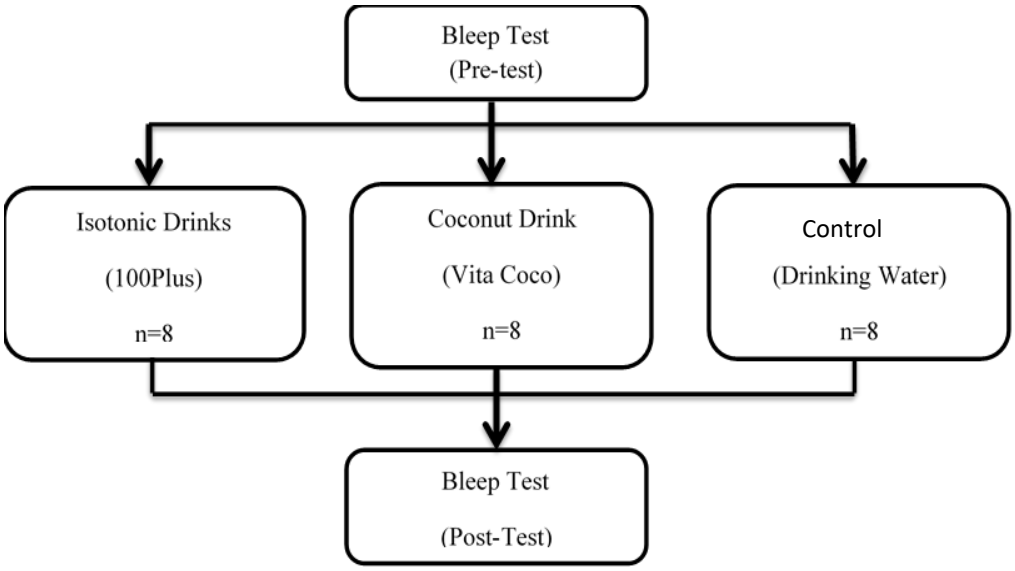

Figure 1. Research framework

Participants and sampling technique

The sampling technique used was purposive sampling. The total participants in this study were 24 football players from UiTM FC. The participants were determined by some inclusion criteria which were free from any injuries, trained athletes, age from 18-25 years old, and not obese which BMI lower than 30kg/m². For the intervention, IDG (n=8) was given an isotonic drink (100plus) and CDG (n=8) was given a coconut drink (Vita Coco). The CG (n=8) were only given drinking water. This method was used to observe the comparison and effects of each drink to enhance cardiovascular endurance performance. For the exercise experiment, the bleep test was used to measure cardiovascular endurance performances.

Procedure for the intervention

i) Drinks consumption.
The intervention procedure consisted of giving different drinks to different groups. The IDG was given an isotonic drink (100 plus). The isotonic drink provides 27 calories in every 100 ml and its nutritional content are sodium, potassium, chloride, and calcium. The coconut drink (Vita Coco) provides 25 calories for every 100 ml, its nutritional content was similar to 100

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plus with additional vitamin C and it was given to the CDG. The control group only received drinking water with zero calorie and zero nutrient content. The isotonic drink was opened and poured into a jug to degas for three hours before the consumption. The number of drinks given to the participants were differed from one another, depending on how much body water they lost during the exercise (bleep test). All beverages were measured using a measurement cup before it was poured into a labelled paper cup and were given to the participants based on their groups and different body water loss. Before the test begins, participants were told not to take any supplements within 24 hours before testing and there are allowed to keep up their ordinary eating routine. The participants were advised not to engage in strenuous activities two days before and not to exercise on the day of the test. The experiment was held in one day with two sessions of pre-test and post-test.

ii) Bleep test.
The bleep test involves continuous running between two lines 20 meters apart in time to record beeps. The participants stand behind one of the lines facing the second line and begin running when instructed by the recording. After one minute, a sound indicates an increase in speed, and the beeps will be closer together. This will continue for every minute (level). If the line was reached before the beep sounds, the participants need to wait for the sounds before continuing. If the line was not reached before the beep sounds, the participants were given a warning and must continue to run to the line, then turn and try to catch up with the pace within two more beeps. The test will be stopped if the participants fail to reach the line for two consecutive ends after a warning.

Data collection procedure

Before the start of the test (bleep test), the researcher measured the weight and height of the participants to determine their body mass index (BMI) level and they were given 10 minutes for warming up before starting the pre-test of the bleep test. After the end of the pre-test session, the participants were given 2-hour to rest. During rest, the participants need to measure their weight to determine the volume of drink they should consume for rehydrating. Each fluid was consumed in three portions at separate times representing 50%, 40%, and 30% of the 120% fluid loss at 0, 30, and 60 min of the 2-hour rest period (Saat et al., 2002). Then, the participants continue to rest to allow the digestion of the drinks in their bodies for one hour. During the rest time, participants were asked on their feeling of nausea or any stomach upset after drinking the fluid. After that, the participants continue with the post-test (bleep test). The data were recorded during the pre-test and post-test. The level of VO^2 max was determined based on the bleep test data using the equation as shown in Eq. (1) below (Ahmaidi et al., 1992):

Eq. (1)
VO^2 max = 31.025 + (3.238 × velocity) - (3.248 × age) + (0.1536 × age × velocity).
(Velocity = the distance covered in 30 seconds during the last stage of the test)

Ethical approval

This study was approved by the Ethics Committee for Research Involving Human Subjects, under Research Management Center of Universiti Teknologi MARA, approved this study (Approval No. 600-IRMI (51/6) dated 26 April 2019).

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Data analysis

All data were presented as mean and standard deviation while the significant level was set at $p \leq 0.05$. The descriptive analysis described the demographic data of the participants such as age, body weight, and height. For inferential statistics, one-way ANOVA was used to determine any significant difference among groups and the demographic variables, meanwhile General Linear Model repeated measures ANOVA also known as mixed between-within subjects' analysis of variance was used to determine the significant difference between-subjects and within-subjects.

RESULTS & DISCUSSION

Table 1 shows the demographic and physical characteristics of the participants according to groups. Participant's age was between 18 – 25 years old and the mean age for IDG, CDG, and CG were 20.63 (0.74), 20.00 (0.00), 20.13 (0.83) respectively. There was no significant difference in age among these three groups. From Table 1, participants from IDG have the highest mean body weight 66.26 (4.90) kg, followed by participants from CG 64.80 (7.21) kg, and CDG 64.44 (6.02) kg. For height, participants from IDG were taller with a mean height of 173.50 (5.63) cm compared to participants from CG with a mean height of 170.66 (4.38) cm and CDG with a mean height of 169.38 (3.20) cm. The overall participants' mean BMI was 22.26 (1.91) which was categorized as normal weight. There was no significant difference for all the physical characteristics among the three groups.

Table 1. Demographic and physical characteristics of the participants according to group

Characteristics	IDG (n=8) Mean (SD)	CDG (n=8) Mean (SD)	CG (n=8) Mean (SD)	Overall (n=24) Mean (SD)	F (p-value)
Age	20.63 (0.74)	20.00 (0.00)	20.13 (0.83)	20.25 (0.68)	2.100 (0.147)
Weight (kg)	66.26 (4.90)	64.44 (6.02)	64.80 (7.21)	65.17 (5.90)	0.199 (0.821)
Height (cm)	173.50 (5.63)	169.38 (3.20)	170.66 (4.38)	171.18 (4.66)	1.748 (0.198)
Body mass index, BMI (kg/m^2)	22.11 (2.09)	22.49 (2.37)	22.18 (1.40)	22.26 (1.91)	0.081 (0.922)

Table 2 shows the quantity of drinks consumed by the participants according to groups, the mean volume of drink consumed was highest in the IDG 630.90 (52.69) ml, followed by CDG with a mean of 440.10 (14.62) ml and lastly the CG with a mean volume of 340.20 (13.19) ml. There was no significant difference between the drinks consumed among the three groups. However, looking at the volume of drinks consumed between groups, suggests that the amount of drink consumed by the participants was based on the taste and palatability of the drink. IDG consumed the most volume of drink, followed by the CDG and CG. This finding is contrary to the study by Saat et al. (2002), which found coconut water significantly sweeter and was easier to consume in a larger amount compared with the carbohydrate-electrolyte beverage and plain water ingestion. Meanwhile, a study by Peart et al. (2017) found that there were subjective differences between the beverages for taste between coconut water and plain water, resulting in a significantly reduced volume of voluntary intake in the coconut water for the study

Malaysian Journal of Sport Science and Recreation
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subjects. During this study, none of the participants were reported to experience any problem related to stomach discomfort caused by drinking the isotonic drink or coconut drink, which differ compared to the previous study where the participants were feeling bloated and experienced mild stomach upset after drinking the coconut water (Kalman et al., 2012; Khan, 2003)

Table 2: Drink consumed by the participants according to group.

Characteristics	IDG (n=8) Mean (SD)	CDG (n=8) Mean (SD)	CG (n=8) Mean (SD)	Overall (n=24) Mean (SD)	F (p-value)
Drink consumed (ml)	630.90 (52.69)	440.10 (14.62)	340.20 (13.19)	470.40 (33.50)	1.735 (0.201)

Table 3 shows the multivariate tests within-subjects interaction effects. A mixed between-within subjects' analysis of variance was conducted to assess the impact of the intervention (by giving three different drinks to three assigned groups) on participants' level of VO^2 max across two times (pre-post-test). There was no significant interaction between groups and the pre-post-test VO^2 max level, Wilks' Lambda = 0.885, F (2, 21) = 1.368, p = 0.276, partial eta squared = 0.115. There was a significant main effect for pre-post-test VO^2 max level, Wilks' Lambda = 0.434, F (1, 21) = 27.370, p = 0.000 ($p<0.05$), partial eta squared = 0.566, within groups showing increment in the level of VO^2 max at post-test (see Table 4). This finding suggests there was a positive change in the level of pre-post-test VO2 max for all three groups across the two different periods. The partial eta squared result of 0.566 suggests a large effect size for this study. This proof that ingesting drinks after pre-test substantially improved the participants' VO^2 max level at post-test. According to Colakoglu et al. (2016), with the help of appropriate drinks, the depleted levels of water, carbohydrates, and electrolytes can be replaced.

Table 3: Multivariate tests within-subjects interaction effects

Effect	Wilks' Lambda value	F	p-value	Partial Eta Squared
Pre-post-test VO2 max level	0.434	27.370	0.000	0.566
Pre-post-test VO2 max level * group	0.885	1.368	0.276	0.115

Table 4 shows the mean level of VO2 max at pre-test and post-test and the between-groups effects. The mean level of VO^2 max for IDG, CDG and CG at pre-test were 47.53 (6.32) ml/kg/min, 47.01 (3.45) ml/kg/min, and 47.06 (3.11) ml/kg/min respectively. At post-test, each group showed an increment in the level of VO^2 max with mean level for IDG was 49.46 (5.88) ml/kg/min, followed by CDG with the mean level of 48.81 (3.29) ml/kg/min and lastly, CG means level was 47.91 (3.43) ml/kg/min. Although there were increments within the group, however, the main effect comparing between these three groups (ingesting different drinks) and their VO^2 max level was not significant, F (2,21) = 0.106, p = 0.900, partial eta squared = 0.010, suggesting no substantial difference in the level of VO^2 max between the three groups. This indicates, there was no significant difference in giving different types of drinks during the bleep test that could improve participants' cardiovascular endurance performance. This shows any drinks that the participants took after the pre-test could improve their VO^2 max level in the post-test regardless of the type of drinks. This finding is supported by Peart et al. (2017) which

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stated in their study, coconut water did not significantly improve time trial performance compared with plain water and there were no significant differences between trials for any of the physiological variables measured.

Table 4: Mean differences of VO² max level pre-post-test and test of Between-Groups Effects

Groups	VO2 max (ml/kg/min)			F (p-value)	Partial Eta Squared
	Pre-test Mean (SD)	Post-test Mean (SD)	Difference of Pre-Test and Post-Teat Mean (SD)		
IDG (n=8)	47.53 (6.32)	49.46 (5.88)	1.94 (1.73)	0.106 (0.900)	0.010
CDG (n=8)	47.01 (3.45)	48.81 (3.29)	1.80 (1.08)		
CG (n=8)	47.06 (3.11)	47.91 (3.43)	0.85 (1.01)		

Meanwhile, looking at the results (see Table 4) of pre-test and post-test level of VO² max within the groups, the IDG group have the most improvement in the level of VO² max compared to the other two groups, this is because sports drinks are made to deliver a right amount of carbohydrate and fluid to allow an athlete to simultaneously rehydrate and refuel after and during the exercise (Guleria et al., 2018). There is a possibility that carbohydrate feeding during vigorous exercise maintained or improved performance by maintaining blood glucose levels when muscle glycogen stores are diminished (Cheuvront & Sawka, 2005; Simulescu et al., 2019). This is in accordance with Burke et al. (2005), which stated exogenous carbohydrates stabilize or increase the circulating glucose concentration and delay fatigue. This study found that CDG does not show any superior improvement on VO² max performance at post-test as compared to the IDG. This is different from the study by Chaubey et al. (2017) which stated sodium enriched coconut drink and coconut water has a better effect on the performance as compared to other drinks. Differently, Castillo et al. (2016) stated, plain water has a better rehydration option as measured by urine specific gravity compared to sports drink although sports drink does improve the agility performance of their participants. Athletes in stop-and-go sports including football, are advised to hydrate by ingesting a carbohydrate-electrolyte solution to help maintain performance and reduce the perception of effort in the later stages of practices and games (Palmer et al., 2017).

CONCLUSION

In conclusion, evidence from this study showed that there was a positive change in the participants' pre-post-test VO² max level for all three groups across the two different periods, this suggests ingesting drinks between exercises substantially improved the participants' cardiovascular endurance performance. However, the interaction effect between the pre-post-test of VO² max level and the three groups was not significant, indicating that there was no significant difference in giving a different type of drinks between the pre-test and post-test that could improve participants' cardiovascular endurance performance. In this study, the type of drinks given to the different groups does not show any significant difference amongst the three groups. This indicates the type of drink does not influence the cardiovascular endurance

performance among the participants. This study shows the importance of rehydration during exercise that could positively affect and improves the football players' VO^2 max level. Future research should include a hydration assessment to investigate the relationship between hydration level, amount of drink consumed, and cardiovascular endurance performance and should involve a larger sample size.

Author's Contribution

Siti Soraya Mohd Elias – Conducted the main writing, data analysis, edited, and produce the final version of the article.
Muhammad Alif Zulkifli – Conducted the data collection and the data analysis of the research.
Noor Fatihah Ilias – Revised the methodology, content, and the final version of the article.

Conflict of Interest

The authors declare no conflict of interest.

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