EFFECTS OF CHOCOLATE MALT DRINK INGESTION PRE-EXERCISE ON EXERCISE PERFORMANCE IN YOUNG MALES

By

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ABSTRAK

PENGENALAN: Minuman malt coklat yang mengandungi karbohidrat dipercayai dapat meningkatkan prestasi senaman. Kajian ini bertujuan untuk menyiasat keberkesanan pengambilan minuman malt coklat (CMD) pra senaman ke atas prestasi senaman berbanding dengan minuman sukan (SPD) dan air kosong (PW).

METODOLOGI: Seramai 20 subjek lelaki muda yang berumur di antara 19-25 tahun menyertai kajian ini. Setiap subjek diminta untuk menghabiskan 3 kali 'randomized cross over' larian 2.4 km dengan 3 minuman ujian yang berbeza (minuman malt coklat, minuman sukan atau air kosong) pada 3 minggu yang berbeza, diselang dengan satu minggu. Subjek perlu mengelakkan daripada melakukan senaman yang memenatkan 24 jam sebelum larian 2.4 km. Subjek juga diminta supaya tidak mengambil sebarang makanan (kecuali air) 8 jam sebelum larian 2.4 km. Subjek juga diminta untuk mencatatkan permakanan harian sendiri, iaitu selama 3 hari sebelum larian 2.4 km yang pertama. Selepas itu, subjek perlu mengikut permakanan harian tersebut 3 hari sebelum larian 2.4km yang kedua dan ketiga. Pada hari larian 2.4km, subjek diminta mengambil minuman ujian (300 mL) 15 minit sebelum larian dimulakan. Selepas itu, subjek diminta untuk menjawab skala sensasi minuman. Kadar denyutan jantung subjek diukur dengan menggunakan pencatat denyutan jantung yang dipakai sepanjang masa larian 2.4 km dijalankan. Subjek diminta untuk lari secepat mungkin untuk mencapai masa larian yang terbaik dalam setiap ujian. Pada akhir ujian larian, kadar denyutan jantung pasca senaman, tahap keletihan (Skala BORG's) dan skala sensasi minuman subjek dicatatkan.

KEPUTUSAN: Keputusan menunjukkan tidak ada perbezaan yang signifikan ($p>0.05$) antara tiga jenis minuman ujian dari segi prestasi masa larian. Masa larian untuk setiap minuman ujian adalah SPD (11.33 ± 1.15 min), PW (11.44 ± 1.15 min) dan CMD (11.59 ± 1.34 min). Selain itu, tidak ada perbezaan yang signifikan ($p>0.05$) dikesan antara tiga minuman ujian tersebut dari segi kadar denyutan jantung pasca senaman dan tahap keletihan subjek. Dari segi sensori minuman bagi ketiga-tiga jenis minuman, keputusan menunjukkan sensori dahaga, loya dan ketidakselesaan perut yang dinilai oleh subjek adalah lebih tinggi secara signifikan ($p<0.05$) selepas senaman berbanding dengan sebelum senaman. Di samping itu, tiada perbezaaan yang signifikan diperhatikan pada sensori kenyang pada pasca senaman berbanding dengan pra senaman bagi ketiga-tiga jenis minuman. Nilai-nilai sensori manis pada minuman malt coklat dan minuman sukan adalah lebih tinggi ($p<0.05$) daripada air kosong pada pra senaman.

KESIMPULAN: Kajian ini menunjukkan pengambilan minuman malt coklat pre senaman memberikan kesan yang lebih kurang sama dengan pengambilan minuman sukan dan air kosong dari segi prestasi larian, kadar denyutan jantung pasca senaman dan tahap keletihan senaman. Di samping itu, nilai-nilai sensasi dahaga, loya dan ketidakselesaan perut yang sedikit lebih tinggi selepas senaman dapat diperhatikan dengan pengambilan minuman malt coklat, minuman sukan dan air kosong.

EFFECTS OF CHOCOLATE MALT DRINK INGESTION PRE-EXERCISE ON EXERCISE PERFORMANCE IN YOUNG MALES

ABSTRACT

INTRODUCTION: Chocolate malt drink which contains carbohydrate is believed able to enhance exercise performance. The purpose of this study was to investigate the effects of chocolate malt drink (CMD) ingestion pre-exercise on exercise performance compared to sports drink (SPD) and plain water (PW) in physically active young males.

METHODOLOGY: Twenty male subjects with age between 19 to 25 years old were recruited in this study. Each subjects were required to undergo three randomized cross over 2.4 km running trials with three different test drinks (Chocolate malt drink, sports drink or plain water) on three different days, with one week apart. The subjects were required to refrain from any strenous exercise for 24 hours. There were also required to fast (water intake was permitted) for 8 hours prior to the running trial. In addition, the subjects were required to record the daily dietary intake 3 days before the 2.4 km run for the first trial. After that, the subjects were asked to follow the daily dietary intake as in the first trial 3 days before the second and the third trial. On the test day, subjects were asked to ingest the test drink (300 mL) 15 minutes pre-exercise. After the test drink ingestion, they were required to answer the fluid sensation scale. Subjects were advised to run as fast as possible to achieve the best timing in each trial. Subjects' post-exercise heart rate, BORG's scale, rate of perceived exertion (RPE) and fluid sensation scale were recorded at the end of the running trials.

RESULT: The result revealed that there were no significant ($p>0.05$) difference in running time performance between all the three test drinks. The running time in each test drink was SPD (11.33 ± 1.15 min), PW (11.44 ± 1.15 min) and CMD (11.59 ± 1.34 min). Besides that, there were no significant ($p>0.05$) difference in post-exercise heart rate and rate of exertion between all the three test drinks. In term of fluid sensation scale, there were significant ($p<0.05$) higher value on thirst, nausea and stomach upset sensations in post-exercise compared to pre-exercise. Meanwhile, there was no significant ($p>0.05$) difference in fullness sensation in post-exercise compared to pre-exercise in all the three test drinks. There were significantly higher values ($p<0.05$) of sweetness sensation in both Cmd and Spd compared to Pw in pre-exercise.

CONCLUSION: The results revealed that pre-exercise Cmd ingestion produced almost the similar effects than that in Spd and Pw in term of running time, post-exercise heart rate and rate of perceived exertion. Meanwhile slight higher value of thirsty, nausea and stomach upset sensations were observed following exercise with Cmd, Spd and Pw.

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Nowadays, public are encouraged to engage in exercise in order to avoid sedentary lifestyle or physically inactive. Sedentary lifestyle or physically inactivity may lead to the development of chronic diseases such as cardiovascular diseases, mental health problems, cancers and metabolic diseases such as obesity, hypertension.

Physical activity is the body movement that produced by the contraction of skeletal muscle which involve energy expenditures. Exercise is the planned, structured, repetitive and purposive physical activity which is important to improve and maintain an individual's physical fitness. Individual's cardiorespiratory fitness can be assessed through various fitness tests, and one of the tests is 2.4 km running test. The 2.4 km run test is often performed by many schools in physical education classes so that the students can be monitored with regards to their current cardiovascular endurance fitness level as well as improvements that are made throughout the year.

Milo® chocolate malt makes up mainly of cocoa, malt and milk. The ingredients of Milo® chocolate malt include malt extract such as barley, skimmed milk powder, maltodextrin, sugar, cocoa, palm oil, minerals and vitamins (Appendix A). Regarding nutritional supplementation and exercise performance, it was believed that the consumption of chocolate malt drink pre-exercise may increase the efficiency of the exercise performance. This is based on the fact that chocolate malt (Milo®) which contains high level of carbohydrate can provide high instant energy pre-exercise. Besides that, chocolate malt (Milo®) which is enriched with Actigen-E and Protomalt may further facilitate the efficiency of energy and nutrients supply to human body.

Sweating during exercise can cause losses in body fluids and essential ions. Thus, this proposes the formulation of beverages for ingestion pre-exercise (Gisolfi and Duchman, 1992). Hydration is important for ensuring high exercise performance. Carbohydrate (CHO) ingestion in the form of a drink can improve exercise performance by maintaining blood glucose levels and sparing endogenous glycogen stores (Caitlin Campbell et al., 2012). Understanding the effects of drinks supplementation pre-exercise may give insight on the benefits of nutritional drink on exercise performance in public. Thus, the present study aimed to investigate effects of chocolate malt drink ingestion pre-exercise on 2.4 km running performance in physically active young males. The ingestion of plain water and sport drink pre-exercise were used to compare their effects with the ingestion of chocolate malt drink.

1.2 Objective

The objectives of this study were to investigate the effects of chocolate malt drink (20g of chocolate malt powder mixed with 300mL plain water) ingestion pre-exercise (15 minutes before the exercise) on 2.4 km running performance compared to plain water (300mL) and sports drink (300mL of 100 plus sports drink) in physically active young males.

1.3 Hypothesis

Null hypothesis (Ho)

There are no significant differences on running time performance, post exercise heart rate, rate of perceived exertion and fluid sensation scale among chocolate malt drink, sport drink and plain water ingestion pre-exercise.

Alternative hypothesis (H_A)

There are significant differences on running time performance post exercise heart rate, rate of perceived exertion and fluid sensation scale among chocolate malt drink, sport drink and plain water ingestion pre-exercise.

1.4 Significance of the Study

The results of the present study can be used as guidelines if it is shown that chocolate malt drink ingestion pre-exercise can elicit positive effects on exercise performance. If it is found that there is positive effects of the pre-exercise ingestion of chocolate malt drink on exercise performance, thus ingesion of chocolate malt drink pre-exercise can be recommended to athletes and public for enhancing exercise performance.

CHAPTER 2

LITERATURE REVIEW

2.1 Benefits of Physical Activity and Exercise

Physical activity is defined as any bodily movement that produced by the contraction of the muscles that increase energy expenditure. Meanwhile, exercise is defined as the physical activity that is planned, structured, repetitive and purposive with the objective of improvement or maintenance of physical fitness.

The physical health benefits of participating in regular physical activity and maintaining physical fitness are well-documented (Department of Health, 2004; United States Department of Health and Human Services, 2008). Regular participation in physical activity can improve physical fitness such as health-related fitness and skill-related fitness. Exercise can improve cardiovascular fitness, enhanced muscle strength and endurance (Strong *et al.*, 2005) and improved body composition (Mavridis *et al.*, 2005). Besides that, regular participation in physical activity enhance psychological well-being (Scully *et al.*, 1998; Hassmen *et al.*,2000) by enhanced self-perception, increased self-esteem and reduced depression, anger and stress.

2.2 2.4 km Running Test

The 2.4km run test is a simple running test of aerobic fitness. In this test, subject is required to complete the distance of 2.4 km in the shortest possible time. The objective of the 2.4km run test is to monitor the development of an individual's aerobic capacity such as VO_2 max. The test result can be used for predicting an individual's potential times at 1500 m, 5 km and 10 km running performance (Burger et al., 1990; Mackenzie, 2005).

The 2.4 km run time test is commonly used in training programmes as its result can be used as an indicator of aerobic capacity. The 2.4 km run time in the field reliably predicts VO_2 max measured during treadmill exercise in the laboratory (Burger et al., 1992).

The 2.4 km run test is a good aerobic fitness test because it includes minimal equipment required compared to laboratory running test, in which only a 2.4 km flat surface, stopwatch and assistant are required. The test is simple to set up and to be conducted. More participants can be assessed at the same time compared to laboratory running test (Burger et al., 1990; Mackenzie, 2005).

2.3 Hydration and Exercise Performance

Hydration is important for an individual to undergo the exercise smoothly, at the same time to enhance the exercise performance. In a previous study regarding the relationship between dehydration and resistance exercise performance, it was reported that dehydration approximately 3% of body weight loss impaired resistance exercise performance, decreased repetitions, increased perceived exertion, and hindered heart rate recovery (Kraft JA et al., 2010). The results in this previous study highlighted the importance of adequate hydration during resistance exercise sessions.

In a previous study regarding the effect of exercise-induced dehydration on endurance performance, under situations of fixed-exercise intensity which may have some relevance for military and occupational settings, exercise-induced dehydration $\geq$ 2% bodyweight was associated with a reduction in endurance capacity, thus the authors suggested that aerobic exercise participants are encouraged to drink according to thirst during exercise (Goulet ED. 2012).

According to Stöhr et al., (2011), dehydration reduces endurance capacity for reasons. Dehydration-induced reductions in stroke volume at rest and during exercise are the result of reduced left ventricular filling, as reflected by the decline in end-diastolic volume. The concomitant maintenance of left ventricular mechanics suggests that the decrease in left ventricular filling, and consequently ejection, is likely caused by the reduction in blood volume and/or diminished filling time rather than impaired left ventricular function.

The importance of ensuring euhydration before exercise and the potential benefits of temporary hyperhydration with sodium salts or glycerol solutions have been mentioned by Shirreffs *et al.*, (2004). It was reported that during 2 hours of exercise, pre-exercise hyperhydration could significantly decrease heart rate and perceived thirst, but rectal temperature, sweat rate, perceived exertion and perceived heat-stress did not differ between hyperhydration and euhydration conditions. Meanwhile, pre-exercise hyperhydration could significantly increase time to exhaustion and peak power output, compared with pre-exercise euhydration (Goulet *et al.*, 2008).

Hyperhydration is the situation when indiviudals "suspect" the exercise they intend to do could produce a loss of more than 1.5-2% of their body weight, or 2 to 3 pounds for a 150-pound person. Then, the decision to go forward with the hyperhydration procedure is made based on whether the advantages of hyperhydration are considered superior to its temporary disadvantages, which are an increased body weight, urine production and incidence of gastrointestinal discomfort (Goulet, 2001). Meanwhile, euhydration is the situation when individuals drink just enough water to maintain euhydration level with 300-500 milliliters of diluted sports drink (3-4%) one hour before exercise and then take in an additional 300-500 milliliters (1-2.5%) 25 minutes before exercise (Goulet, 2001). It is more difficult to hyperhydrate prior to exercise and although there has been interest in glycerol ingestion, to date research results have been equivocal. At the very least, individuals should ensure euhydration prior to exercise (Hargreaves, 2001).

Sweating during exercise can cause losses in body fluids and essential ions. Thus, this proposes the formulation of beverages for ingestion pre-exercise (Gisolfi and Duchman, 1992). It is expected by the authors that, with different test drinks consumed before a running test, different running time performance can be observed, in which subjects' running time performance reflects cardiorespiratory fitness. It is believed that proper nutritional supply pre-exercise is important to improve the exercise performance and to prevent inadequate of nutrients during exercise which may deteriorate the body function (Gisolfi and Duchman, 1992).

Carbohydrate ingestion in the form of a drink is believed can improve exercise performance by maintaining blood glucose levels and sparing endogenous glycogen stores, because it was reported by Campbell et al. (2012) that carbohydrate-supplements are effective in maintaining blood glucose levels during exercise and improving exercise performance compared with plain water only (Campbell et al., 2012).

Loss of body water, if sufficiently severe can impair most physiological functions (Maughan, 2012). The act of drinking itself and the conscious denial of access to water can also have implications for subjective responses to the exercise task. According to Maughan (2012), it is difficult to separate the effects of ingestion of water from those of carbohydrate, electrolytes, and other drink components. Nevertheless, there is good evidence that drinking appropriate amounts of water can enhance exercise performance in many situations (Maughan, 2012).

According to White and Ford (1983), in both replacement of water or an experimental sport drink, selected physiological indices of work performance were maintained closer to homeostatic levels during exercise, with a more rapid return to pre-exercise resting levels during recovery than during that in exercise dehydration without fluid replacement. Furthermore, replacement of water or sport drink are equally effective in preventing plasma volume changes during exercise and restoration to pre-exercise levels during recovery, as well as in preventing plasma osmolality disturbances during exercise and recovery. Thus, the authors mentioned that both the ingestion of water and sport drink pre-exercise may produce the ideal effect on exercise performance.

According to Singh (2003), carbohydrate-electrolyte fluid ingestion during exercise has the dual role of providing a source of carbohydrate fuel to supplement the body's limited stores, and supplying water and electrolytes to replace the losses incurred by sweating. In addition, pre-exercise carbohydrate ingestion can elicit maximal fat oxidation. Maximal fat oxidation rates can be decreased when carbohydrate was ingested before the start of exercise. Based on a previous study, it was found that maximal power output was higher in the carbohydrate trial than in the placebo trial as the result of the ingestion of carbohydrate before the onset of exercise with decreased fat max by 14% (Achten & Jeukendrup, 2003).

Sports drinks containing carbohydrates and electrolytes are marketed throughout the world as a replenishing source of energy for fatigued athletes for greater endurance. Pre-exercise sports drinks ingested are commonly used as ergogenic aids in athletic competitions requiring aerobic power and pre-exercise sports drink has been reported can lead to maximal aerobic performance during a graded exercise test (Byars et al., 2010). It was suggested that the exposure to a sport drink led to improved endurance relative to exposure to spring water (Friedman & Elliot, 2008).

2.4 Milo® Chocolate Malt Powder

Milo® chocolate malt makes up mainly of cocoa, malt and milk. The ingredient of Milo® chocolate malt include malt extract such as containing barley, skimmed milk powder, maltodextrin, sugar, cocoa, palm oil, minerals and vitamins (Appendix A). Milo® chocolate malt which contains high level of carbohydrate may provide high instant energy pre-exercise. Therefore, it was hypothesized by the authors that Milo® chocolate malt is effective in maintaining blood glucose levels before and during exercise for improving exercise performance. Besides that, chocolate malt (Milo®) which is enriched with Actigen-E and Protomalt may further facilitate the efficiency of energy and nutrients supply to human body. Actigen-E is a combination of 8 vitamins and 4 minerals that help to optimize the release of energy from foods. On the other hand, protomalt is a special malt extract that provides a mixture of different types of carbohydrate including glucose, maltose, oligosaccharide and poligosaccharide, which provide energy and nutrients that body needs (Nestlé (Malaysia) Ltd. Company, 2012). 300mL of carbohydrate beverage was recommended pre-event, thus, the amount of test drinks taken in this study was 300 mL for each test drinks (Gisolfi & Duchman, 1992).

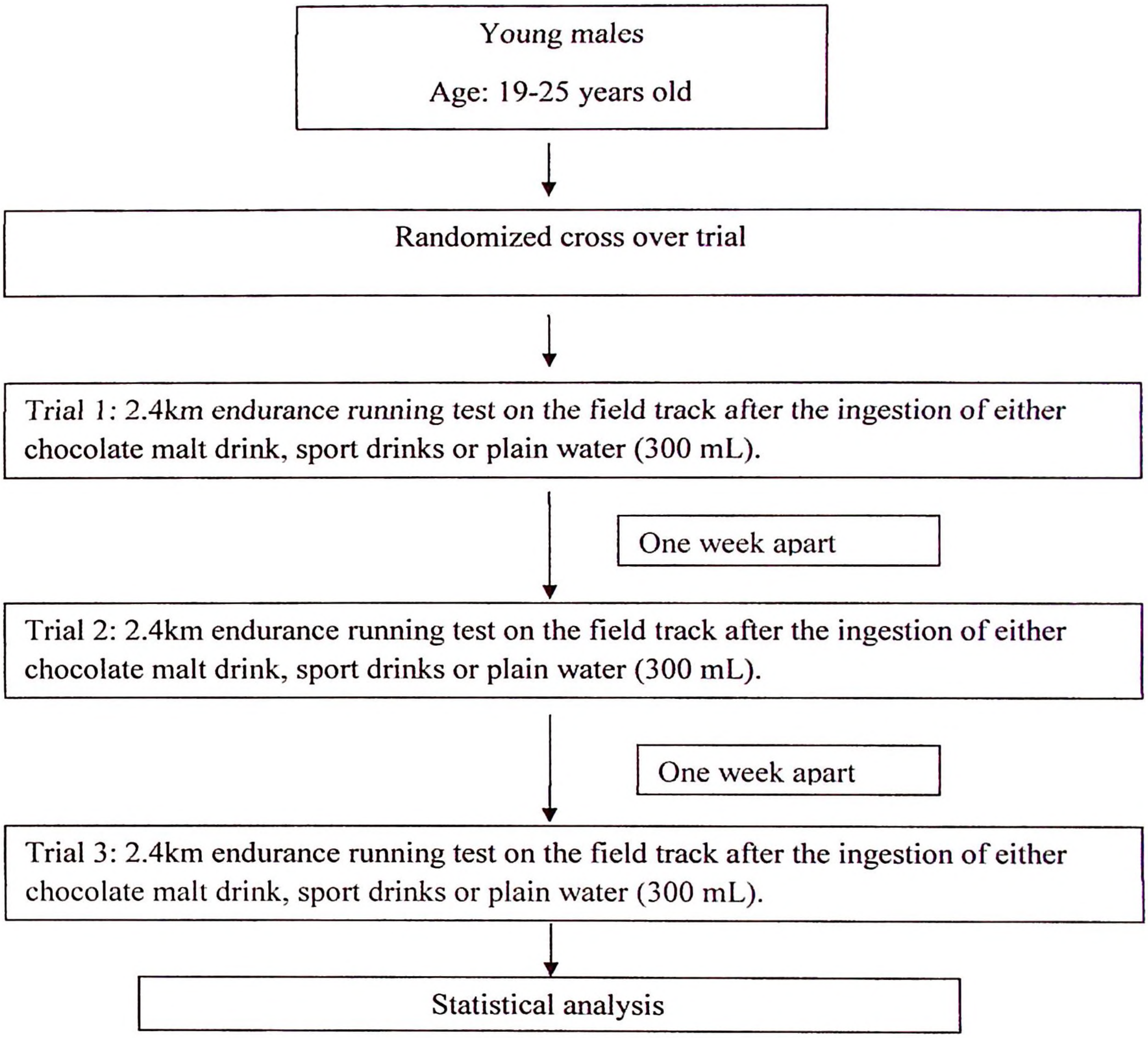
CHAPTER 3

MATERIALS AND METHODS

3.1 Subjects

In this study, twenty young Malaysian young male subjects age ranging between 19 to 25 years old were recruited from Health Campus of Universiti Sains Malaysia (USM) (Figure 1). The inclusion criteria of the subjects include: free from health problem, non smoker and physically active males with exercise more than two times per week. The subjects were required to accomplish three randomized cross over 2.4 km endurance running trials with three different test drinks (either chocolate malt drink, plain water or sport drinks), with one week apart. The study was expected to last up to three to five weeks for each subject. Participation as a subject in this study was on a voluntary basis. Thus, the subjects have the right to withdraw themselves from this study at any time during the course of this study. The subjects were required to sign on the research information and consent form (Appendix B) before the commencement of the tests. The present study was approved by the Human Research Ethical Committee USM (Appendix C).

Figure 1: Flow chart of the experimental design



3.2 Sample Size Calculation

Sample size used in this study was calculated by using PS Power and Sample Size Calculation version 3.0.43. Based in a study which was carried out by Faizal Abdul Manaf (2010) A Comparitive Analysis of Post-exercise Supplementation of Isocaloric Sago, Sago-soy and Sports Drink on Subsequent High Intensity Cycling Performance (MSc Sports Science Thesis, Sports Science Unit, USM).The power of study was set at 80% with 95% confident interval, the standard deviation (σ) observed was 3.90 min of exercise time as indicator of sports performance, and difference in population means (δ) was set at 2.6 min. The calculated sample size is 20 subjects.

3.3 Procedure

The venue to carry out this study was the track field in Sport Complex, Health Campus, USM Kubang Kerian, Kelantan, Malaysia. The subjects underwent three running trials with test drinks on three different days with one week apart. The subjects were asked to refrain from any strenuous exercise 24 hours and to fast 8 hours prior to the running test. They are asked to record and follow the daily 3-day dietary intake as recorded in dietary diary (Appendix D) in the first trial, 3 days before the 2.4 km run.

On the test day, each subject was required to perform the randomized cross over 2.4 km running trial. They were required to ingest the test drink prepared by the researcher (1 test drink out of 3 test drinks in each trial) 15 minutes pre-exercise. After the test drink ingestion, the subjects were asked to answer the fluid sensation scale to determine their response on the test drink ingested.

After 15 minutes of rest following the test drink ingestion, subjects were asked to carry out stretching exercise as the warm-up preparation prior to the 2.4 km running trial. Before the run, the subjects were worn with heart rate monitor. The running time performance of each subject was recorded with a stopwatch. They were encouraged to run as fast as possible to achieve the best timing of them during the trial.

Immediately after the subjects completed the 2.4 km run, their post-exercise heart rate were recorded according to the result showed in the heart rate monitor. The subjects were required to response to the rate of perceived exertion, BORG's scale and fluid sensation scale immediately after the running time and heart rate were taken.

3.4 Measured Parameters

3.4.1 Fluid Sensation Scale

Fluid sensation scale of thirst, sweetness, nausea, fullness and stomach upset were responded by the subjects before and after the 2.4 km run. The contents of the fluid sensation scale varying from 1 to 5 are illustrated in Appendix E. Lightest sensation is rated as "1" and strongest sensation is rated as "5".

3.4.2 Rate of Perceived Exertion (BORG's Scale)

Rate of perceived exertion (BORG's scale) was responded by the subjects immediately after the 2.4 km run test. It was used to determine the rate of exertion perceived by the subjects following the running test. BORG's scale consists of the rate of exertion of work ranging from 6 to 20. Lightest effort is rated as "6" and maximal effort is rated as "20". The subjects were required to response the running effort they had done based on the scale subjectively.

3.4.3 Running Time Performance of the 2.4 km Running Endurance Test

Subjects were required to perform their best by running as fast as possible to complete the running trial with their shortest time to cover the distance of 2.4 km. The running time was recorded by a stopwatch.

3.5 Test Drinks

3.5.1 Milo® Chocolate Malt Drink Preparation and Related Calculation

As the preparation, 20g of Milo® chocolate malt powder was mixed with 300ml of plain water for each subject. The amount of chocolate malt powder was calculated based on the concept of "isocalories" of both Milo® chocolate malt powder and 100 plus sports drink as shown below:

According to Gisolfi and Duchman (1992), 300mL of carbohydrate beverage is recommended pre-event. Thus,

<u>100 plus sports drink</u>

Each 100mL of 100 plus sports drink → 27 kcal of energy

300mL of 100 plus sports drink → 81 kcal of energy

<u>Milo® Chocolate Malt Drink</u>

30g of chocolate malt powder → 124 kcal of energy

1g of chocolate malt powder → 4.133 kcal of energy

For producing 81 kcal of energy, 19.6g (~20g) of milo® chocolate malt powder was needed.

The test drink temperature was set at the room temperature before given to the subjects. For Milo® chocolate malt drink, it was prepared 1 hour before the run test early in the morning. The prepared test drink was brought to the track field. Before the running test, 300ml of Milo® chocolate malt drink was consumed by the subjects in plastic cups.

3.5.2 Sport Drinks (100 Plus)

100 plus drink (Product of Malaysia) was chosen to be the sport drink used in this study. As the preparation, the bottles containing 100 plus sport drinks were brought to the track field. Before the running test, 300 ml of 100 plus sport drink were poured into plastic cups and consumed by the subjects.

3.5.3 Plain water (Mineral water)

Mineral water was used as plain water in the present study. It was brought to the track field. 15 minutes before the running test, 300 ml of mineral water were poured into plastic cups and consumed by the subjects.

3.6 Statistical Analysis

Statistical analysis was done by using statistical software contained in the Statistical Package for Social Science (SPSS) Version 18.0. After checking normality and homogeneity, either one-way analysis of variance (ANOVA) or Kruskal Wallis test was used to determine the significance of the difference between drinks in running time, rate of perceived exertion (RPE), post-exercise heart rate and sweetness sensation in fluid sensation scale. Two-ways ANOVA was performed to determine the significance of the difference of fluid sensation scale in thirst, nausea, fullness and stomach upset sensation between pre- and post-exercise, and between the test drinks.

Data were presented as mean ± standard deviation (SD) or median ± interquartile range. Statistical significance was accepted at $p<0.05$.

CHAPTER 4

RESULTS

4.1 ANTHROPOMETRIC DATA OF SUBJECTS

Twenty physically active males were recruited as subject. All the subjects successfully completed the trials during the experimental period. The mean age of the subjects was 21.9 ± 1.1 years old, mean body height was 172.0 ± 7.5 cm, mean body weight was 66.3 ± 10.8 kg and mean percentage of body fat was 15.8 ± 5.4% (Table 4.1).

Table 4.1: Mean age, body height, body weight and percentage of body fat of the subjects (N=20)

Parameters	Mean± SD
Age (years)	21.9 ± 1.1
Body height (cm)	172.0 ± 7.5
Body weight (kg)	66.3 ± 10.8
Body fat (%)	15.8 ± 5.4

4.2 RUNNING TIME PERFORMANCE OF SUBJECTS

The mean running time performance tabulated in Table 4.2 showed that running time was the shortest in SPD (11.33 ± 1.15 min), followed by PW (11.44 ± 1.15 min) and CMD (11.59 ± 1.34 min). However, one way ANOVA revealed that there was no statistically significant difference in the running time performance between the three test drinks, i.e. CMD, SPD and PW.

Table 4.2: Running time performance (minute)

Test drinks	Running time (Mean ± SD)
Chocolate malt drink (CMD)	11.59 ± 1.34
Sports drink (SPD)	11.33 ± 1.15
Plain water (PW)	11.44 ± 1.15

4.3 POST-EXERCISE HEART RATE OF SUBJECTS

Results of post-exercise heart rate are presented in Table 4.3. Kruskal Wallis test revealed that there was no significant difference ($p>0.05$) in median of post-exercise heart rate between all the three test drinks.

Table 4.3: Post-exercise heart rate (beats per minute)

Test drinks	Post-exercise heart rate (Median ± Interquartile range)
Chocolate malt drink(CMD)	191.50 ± 13.75
Sports drink(SPD)	194.00± 10.50
Plain water(PW)	192.00± 13.50

4.4 RATE OF PERCEIVED EXERTION (RPE) OF SUBJECTS

Kruskal Wallis test revealed that there was no significant difference in median of rate of perceived exertion between all the three test drink ($p> 0.05$) as shown in Table 4.4.

Table 4.4: Rate of perceived exertion (RPE)

Test drinks	Rate of perceived exertion (Median ± Interquartile range)
Chocolate malt drink (CMD)	17.00 ± 3.75
Sports drink (SPD)	17.00 ± 3.00
Plain water (PW)	17.00 ± 3.00

4.5 FLUID SENSATION SCALE

4.5.1 Thirst

Results of thirst sensation are shown in Table 4.5.1. Two way ANOVA with repeated measure revealed that there was a significant main effect of time on thirst sensation (P=0.000). However, there was no significant interaction between time and drink on thirst sensation (P=0.287). Separate ANOVA with repeated measure showed that there were significantly higher values of thirst sensation in post-exercise compared to pre-exercise in CMD, SPD and PW ($P<0.05$). Meanwhile, no significant differences were observed between the three drinks in pre- and post-exercise respectively.

Table 4.5.1: Thirst sensation

Test drinks	Thirst sensation	
	Pre-exercise	Post-exercise
Chocolate malt drink (CMD)	1.55 ± 0.95	2.80 ± 0.95[a]
Sports drink (SPD)	1.50 ± 0.69	2.85 ± 0.81[a]
Plain water (PW)	1.15 ± 0.49	2.70 ± 1.30[a]

a, $p<0.05$ compared to pre-exercise.

4.5.2 Sweetness

Kruskal Wallis test showed that there were significantly higher values of sweetness sensation in CMD ($p<0.05$) and SPD ($p<0.05$) compared to PW respectively in pre-exercise (Table 4.5.2).

Table 4.5.2: Sweetness sensation

Test drinks	Sweetness sensation (Pre-exercise)
	Median ± interquartile range
Chocolate malt drink (CMD)	1.50 ± 1.75^{b}
Sports drink (SPD)	2.00 ± 2.00^{b}
Plain water (PW)	1.00 ± 0.00

b, $p<0.05$ compared to PW.

4.5.3 Nausea

Results of nausea sensation are shown in Table 4.5.3. Two way ANOVA with repeated measure revealed that there was significant main effect of time on nausea sensation ($p<0.05$). However, there was no significant interaction between time and drink on nausea sensation ($p>0.05$). Separate ANOVA with repeated measure showed that there were significantly higher values of nausea sensation in post-exercise compared to pre-exercise in CMD, SPD and PW ($p<0.05$). On the other hand, no significant differences were observed in nausea sensation between the three drinks in pre- and post-exercise respectively ($p>0.05$).

Table 4.5.3: Nausea sensation

Test drinks	Nausea sensation	
	Pre-exercise	Post-exercise
Chocolate malt drink (CMD)	1.20 ± 0.41	1.75 ± 0.85^{a}
Sports drink (SPD)	1.10 ± 0.31	2.15 ± 1.14^{a}
Plain water (PW)	1.20 ± 0.52	1.80 ± 1.00^{a}

a, $p<0.05$ compared to pre-exercise.

4.5.4 Fullness

Results of fullness sensation are shown in Table 4.5.4. Two way ANOVA with repeated measure revealed that there was no significant main effect of time on fullness sensation ($p>0.05$). In addition, there were no significant interaction between time and drink on fullness sensation ($p>0.05$).

Table 4.5.4: Fullness sensation

Test drinks	Fullness sensation	
	Pre-exercise	Post-exercise
Chocolate malt drink (CMD)	1.75 ± 0.72	1.65 ± 0.75
Sports drink (SPD)	2.00 ± 0.86	2.15 ± 1.09
Plain water (PW)	2.00 ± 0.80	1.80 ± 0.89

4.5.5 Stomach upset

Results of stomach upset are shown in Table 4.5.5. Two way ANOVA with repeated measure revealed that there was a significant main effect of time on stomach upset sensation ($p<0.05$). However, there was no significant interaction between time and drink on stomach upset sensation ($p>0.05$). Separate ANOVA with repeated measure showed that there were significantly higher values of stomach upset sensation in post-exercise compared to pre-exercise in CMD, SPD and PW ($p<0.05$). Meanwhile, no significant differences were observed on stomach upset sensation between the three drinks in pre- and post-exercise respectively ($p>0.05$).

Table 4.5.5: Stomach upset sensation

Test drinks	Stomach upset sensation	
	Pre-exercise	Post-exercise
Chocolate malt drink (CMD)	1.15 ± 0.49	1.95 ± 0.95 [a]
Sports drink (SPD)	1.40 ± 0.50	2.05 ± 1.28 [a]
Plain water (PW)	1.20 ± 0.41	1.60 ± 1.05 [a]

a, $p<0.05$ compared to pre-exercise.

CHAPTER 5

DISCUSSION

The present study investigated the efficiency of pre-exercise ingestion of chocolate malt drink, sport drink and plain water on 2.4km running performance. Running time performance, rate of perceived exertion (RPE), post-exercise heart rate and the response on fluid sensory scale were among the measured parameter to determine the efficiency of the test drinks on exercise performance.

5.1 Running time performance

Findings of present study revealed that there was no significant difference in running time performance between the test drinks. In other words, the effects elicited by the ingestion of these test drinks were similar in young males.

Non-statistically, the result showed that sports drink ingestion elicited the best exercise performance with shortest running time, followed by plain water and chocolate malt drink ingestion. Previous study showed that the ingestion of plain water and sports drink produce the ideal effect on exercise performance and the ingestion of plain water and sports drink are equally effective in preventing plasma volume changes during exercise, as well as in preventing plasma osmolality disturbances during exercise (White and Ford, 1983). Pre-exercise plain water ingestion has been reported could improve endurance capacity (Fallowfield. et al., 1996). Besides that, it was also reported pre-exercise plain water ingestion can help to attenuate the decline in maximal neuromuscular power during exercise (Ricardo G. Fritzsche. et al., 2000). As a result, the subjects with increased maximal neuromuscular were prone to perform better in running exercise.