EFFECT OF COFFEE CONSUMPTION ON ANAEROBIC PERFORMANCE

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Abstract

The purpose of this study was to determine the effect of coffee ingestion on anaerobic performance of coffee drinkers. Wingate bicycle tests were applied before and after 10 days coffee consumption. In a randomized and double blind design, one group of subjects consumed coffee (3 mg caffeine/kg/day) and other group of subjects consumed decaf coffee for ten days between two Wingate tests. Wilcoxon Signed Ranks Test test were applied between pre and post-tests of the group. Effect size (ES) was calculated using Cohen's delta to evaluate the size of mean differences. Results of this study indicated that peak power increased in just caffeinated coffee group when compared to baseline ($p<0.05$). As a conclusion it can be said that long time coffee with caffeine ingestion has a positive effect on anaerobic performance.

Key Words: wingate, coffee, decaf

1. INTRODUCTİON

People consume caffeine because of many reasons. It is stated that caffeine causes mental alertness increase, a faster and clearer flow of thought and restlessness. Therefore, feeling sleepy is delayed, because fatigue is reduced. The most important determinant for caffeine effect is the amount of taken dose. The dose related effect is underlined that caffeine disruptively effect on sleep latency and quality and objective measure of total sleep time. This situation occurs because caffeine stimulates the heart muscle, the secretion of gastric acid and urine output. It is stated that caffeine increase mental awareness and this causes sustained intellectual effort without significant disruption of coordinated intellectual or motor activity (Harland, 2000; Hindmarch et al., 2000; Spriet, 2014).

Hindmarch et al., (2000) underline the acute effect of caffeine ingestion that caffeinated beverages may maintain aspects of cognitive and psychomotor performance throughout the day and evening if it is taken repeatedly. Harland (2000) summarized the caffeinated drinks as coffee, tea, colas and caffeinated waters and beverages as chocolate products and medications.

Because caffeine is cheap and has no negative effect on health, it is socially accepted amongst sport players and highly used in sport as a perceived ergogenic effect on athletic performance. When the 3 or 6 $mg.kg^{-1}$ body mass caffeine is consumed, it passes the membranes of all the body's tissues in a short time and beneficial to aerobic cycling performance (Desbrow et al., 2012). Furthermore, caffeine as an ergogenic effect has been found to increase speed, power and aerobic endurance (McDaniel et al., 2010). Drinks and beverages containing caffeine and ephedrine have become common substance in the diets of most athletes and popular among sport persons in recent years (Graham, 2001; Magkos and Kavouras, 2004).

Graham (2001) mentioned that caffeine positive effect in intense exercise is controversial, but no negative effect is exist. Therefore, it is suggested that caffeine can be ergogenic in exercise lasting at least 60 seconds. Furthermore, Magkos and Kavouras (2004), underlines the caffeine ingestion effect on exhaustion that caffeine can increase time to exhaustion during submaximal exercise bouts lasting approximately 30–60 minutes. Speed and power output during such activities may also improve.

There are so many effects of caffeine. In this study we concentrate on the caffeine effects on anaerobic performance. Ergogenic effects of caffeine are known. But the ergogenic effect of caffeine and its mechanism of action on short-term, high-intensity exercise are controversial (Greer et al. 2006).

Many of the studies in literature focused on the acute effects of caffeinated coffee or caffeine drug on anaerobic and aerobic performance. Results of many studies show that there are no acute effects of caffeine on anaerobic performance (Hoffman et al., 2007; Greer et al., 2006; Greer et al., 1998).

In addition these studies Roberts et al. (2007), found no JavaFitTM Energy Extreme effects on the results of Wingate test. JavaFitTM Energy Extreme (JEE, Javalution Coffee Co, Fort Lauderdale, FL) is a functional gourmet coffee that contains a proprietary blend of caffeine, garcinia cambogia, chromium polynicotinate, and citrus aurantium, and is marketed to increase energy expenditure.

Some studies are focused on the aerobic effects of caffeine. Coso et al. (2008), investigated the effect of water, carbohydrate, and caffeine ingestion on fatigue was determined during prolonged exercise in the heat. They stated that caffeine ingestion (6 mg-kg-3 body weight) maintains maximum voluntary contraction and increases maximal cycling power despite dehydration and hyperthermia during prolonged exercise in the heat environment. Furthermore, maximal leg force increases by increasing voluntary activation when caffeine ingestion is combined with water and carbohydrate.

Graham et al. (1998), underlines the endurance and metabolism changes during exercise when caffeine ingestion is applied that other compounds in coffee act to antagonize the responses observed when caffeine is ingested independent of coffee.

Thus, while the exercise effects of caffeine have been studied during submaximal and maximal exercise bouts, it is currently unknown how two weeks coffee ingestion affects anaerobic performance. Therefore, the aim of this study was to investigate the effects of coffee ingestion on maximal anaerobic performance in male and female coffee drinkers. Furthermore, we also examined affects of coffee ingestion on anaerobic exercise performance during a Wingate cycle ergometer test.

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2. METHODS

Subjects

Ten males (23.1 ± 1.8 years, 176.2± 0.05 cm, 67.9 ± 7.9 kg, BMI 19.3±1.7) and seven females (23.6 ± 9.9 years, 163.2 ± 0.5 cm, 54.5 ± 20.3 kg, BMI 16.6±6.1) volunteered for the current study. After procedure explanation of research, each subject gave his or her written informed consent to participate for the current study. Local Ethic Comity approved research protocol. Subjects also were asked to avoid from taking any other nutritional supplements or ergogenic aids during the 10 days of the research. Female subjects were not menstruation period.

Determination of Hydration Levels

Scientists and clinicians prefer circulatory and urinary indices to identify dehydration (Grandjean et al., 2000). The aim of pre-hydrating is to start the activity normal plasma electrolyte levels. Dehydration increases physiologic strain as measured by core temperature, heart rate and perceived exertion responses during exercise-heat stress (Sawka et al.. 2007)

So hydration level was determined from urine sample of subjects via refractometer. Subjects who have 1000-1020 hydration levels were included in this study.

Experimental Design

Subjects reported to the Human Performance Laboratory on 2 separate occasions. During the first and second visit, subjects performed 30-second Wingate anaerobic power test. Prior to the start of the test, the subjects were instructed to pedal as fast as possible from the beginning and to attempt to maintain maximum pedal speed throughout the test. At the command ‘‘go,’’ the subjects began pedaling as fast as possible against a low resistance that was increased to 7.5% of the subject’s body weight within 2–3 seconds (Beck et al 2006). In a randomized and double blind design, 9 subjects consumed coffee (3 mg caffeine/kg/day) and 8 subjects consumed decaffeinated coffee for ten days between two Wingate test.

Harland., (2000) pointed out that the amount of caffeine in a “cup” of coffee, tea, or hot chocolate is surprisingly change even though it is prepared by the same person and with the same equipment and ingredients every day. So caffeine ratio in caffeinated coffee and decaffeinated coffee was analyzed in pharmacognosy laboratory. Amount of coffee was determined according to caffeine ratio results individually. Eight subjects consumed caffeinated coffee and control group (nine subjects) consumed decaffeinated coffee. Additionally, heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured before and after wingate test.
Ten days after the first trial, participants performed the second trial under the same conditions as in the first. Tests were applied before and after coffee consumption.

To analyze anaerobic power performance, all subjects performed the Wingate anaerobic power test (Monark 874 E). After a warm-up period of 5 minutes of pedaling at 60 rev.min^{-1} the subjects pedaled for 30 seconds at maximal speed against a constant force. Peak power, mean power, time to peak power, total works were determined. ‘‘Peak power’’ was defined as the highest mechanical power output elicited during the test. ‘‘Mean power’’ was defined as the average mechanical power during the 30-second test.

Statistical Analyze

Non-Parametric Wilcoxon Signed Ranks Test were applied between pre and post-tests of the groups.

3. RESULTS

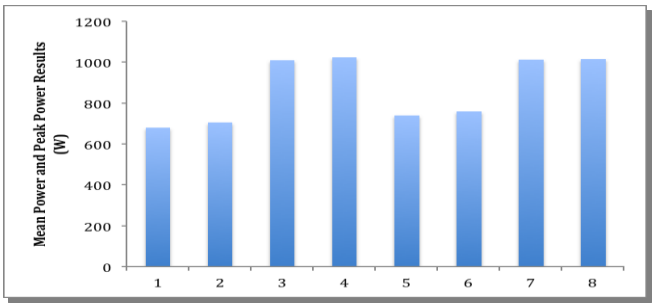
Comparisons of performance results of the wingate test were shown in **Graph 1**. Results of this study indicated that mean power and peak powers both increase in caffeinated coffee group when compared to baseline.

Mean power of coffee consumers groups: pre test, post test responses (679 ±50; 705±57) (p=.028, Z=-2.191[b] (b. Mean power results of post tests are higher than pre test results)).

Mean power of decaffeinated coffee consumers groups: pre test, post test responses (740 ±73; 760±92) (p=.063, Z=--1.859[b]).

Peak power of coffee consumers groups: pre test, post test responses (1010 ±15; 1023±15) (p=.005 Z=-2.812).

Peak power of decaffeinated coffee consumers groups: pre test, post test responses (1012 ±18; 1015±22) (p=.128, Z=-1.521[b]).



Graph 1. Comparison of Performance Results of Wingate Test

1: Mean power of coffee consumers groups (Pre Test)

2: Mean power of coffee consumers groups (Post Test)

3: Peak power of coffee consumers groups (Pre Test)

4: Peak power of coffee consumers groups (Post Test)

5: Mean power of decaffeinated coffee consumers groups (Pre Test)

6: Mean power of decaffeinated coffee consumers groups (Post Test)

7: Peak power of decaffeinated coffee consumers groups (Pre Test)

8: Peak power of decaffeinated coffee consumers groups (Post Test)

4. DISCUSSION

The results of this study indicate that long term coffee with caffeine consumption significantly increase anaerobic performance when compared with decaffeinated coffee. Peak power is more increased than mean power of coffee with caffeine consumers.

Acute caffeine ingestion does not appear to increase one's maximal ability to generate power during short-term cycling exercise (Williams et al., 1988). Results are not supported with this study. The reasons of this situation can be the difference of exercise and coffee consumption protocol. Duration of exercise and whether caffeine ingestion acute or long term can affect the results.

Roberts et al. (2007), investigated the effects of JavaFit Energy extreme functional coffee on aerobic and anaerobic fitness markers in recreationally-active coffee consumers. They found no significant differences between treatments were observed in regards to all of the criterion measures during the Wingate test. Hoffman et al. (2007), also investigated the effects of JavaFit Energy extreme functional coffee on aerobic and anaerobic exercise performance. They also found no significant difference between coffee and placebo ingestion in any of the power performance measures. Greer et al. (1998) searched the caffeine effects during repeated Wingate test. They found that caffeine ingestion did not have any effect on power output (peak or average) in the first two Wingate tests and had a negative effect in the latter two exercise bouts. The performance results are not consistent with this reported by Greer et al. (1998). Bell et al. (2001) investigated the effect of caffeine and ephedrine ingestion on performance of anaerobic exercise. After ephedrine and ephedrine + caffeine ingestion power early in the ride significantly increased compared with the trials when ephedrine was not ingested and caffeine ingested. Greer et al. (2006), found that caffeine increased peak power and mean power. But this effect was not significant. According to the results of Beck et al. (2006), ingestion of the caffeine containing supplement resulted no effect on peak power and mean power.

Literature shows no acute effects of caffeine on anaerobic performance (Roberts et al., 2007; Hoffman et al., 2007; Greer et al., 1998; Bell et al., 2001; Greer et al., 2006; Beck et al. 2006). We sought to examine long time effects of caffeine. It can be the reason of the difference of results of our study and literature.

Doherty et al. (2004), searched the acute effects of caffeine on power output during high intensity cycling. They found that mean power output increased after caffeine ingestion when compare with placebo. So even though the results of studies are supported each other measurement protocols were different.

As a conclusion it can be said that long time coffee with caffeine ingestion has a positive effect on anaerobic performance.

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