Effect of Caffeinated Chewing Gum on Dehydration ability in Bodybuilding Athletes: a crossover trial

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Project summary

The purpose of this study was to investigate the effect of caffeinated chewing gum on dehydration ability in bodybuilding athletes. Methods: 15-20 trained bodybuilding athletes were divided into caffeine gum trial (CAF) and placebo trial (PL) with a randomized, double-blind study design. The participants chewing either caffeine Gum (CAF trial, containing 5 mg/kg of caffeine) or placebo gum (PL) for 10 minutes. After rested for 15 minutes, Participants used the bicycle to adjust the pedal resistance and speed according to their own feelings until they were dehydrated to 2% of their original body weight. Record time from exercise to completion of dehydration, heart rate, HRV, energy expenditure, fat oxidation rate and carbohydrate oxidation rate.

Introduction

Many athletes use caffeine (1, 3, 7-trimethylxanthine) as a nutritional supplement, which is widely available in everyday foods such as coffee, chocolate, tea, cola and energy drinks. Caffeine intake can reduce fatigue by inhibiting adenosine receptors, increase the ability of the sarcoplasmic reticulum to release calcium ions, maintain sodium-potassium ATPase activity, and increase glycolysis before exercise(1, 2), all of which are mechanisms that can significantly increase sprinting speed (3), repetitive sprinting ability, and maximal muscular strength and explosive power (4). These increases in physical performance may be effective in improving athletic performance. Previous studies have shown that a pre-exercise caffeine intake of 3-6 mg per kilogram of body weight can achieve the highest concentration in the bloodstream one hour after

intake (5, 6), resulting in performance enhancement. However, caffeine is slowly absorbed in the gastrointestinal tract and may cause gastrointestinal discomfort or excessive fluid intake (8). Finding alternative forms of caffeine supplementation may reduce gastrointestinal discomfort.

Caffeine supplementation using caffeinated gum before exercise has been found to be absorbed through the oral mucosa at a faster rate than caffeine capsules (7). In a study by Morris et al. in 2019, test subjects chewed gum containing 100 mg of caffeine for 2, 5, and 10 minutes to observe their caffeine absorption rate and blood levels. The results showed that 85% of the caffeine was effectively absorbed after 5 minutes of chewing caffeinated gum, and after 10 minutes, the caffeine in the gum was almost completely absorbed. In terms of blood concentration, the highest concentration of caffeine (8) was observed after 15 minutes of chewing caffeine gum. In terms of exercise performance, chewing gum containing 100-300 mg of caffeine 5-15 minutes before exercise can effectively improve aerobic capacity, slow down the decline of sprinting speed, increase vertical jump height, and enhance the effect of explosive power (9, 10).

Caffeine supplementation has been shown to be effective in enhancing aerobic exercise performance; however, it remains unclear whether chewing caffeine has the same significant effect on dehydration ability in bodybuilding athletes. Therefore, the purpose of this study was to investigate the effect of caffeine chewing gum on dehydration ability by aerobic exercise.

Methods

Design

This study used a randomization crossover design with double-blind experimental design. Participants will be divided into a caffeinated chewing gum trial (CAF) and a placebo trail (PL). The placebo trail (PL). After the first trial, the participants rested and recovered for 7-10 days before the next trial, which was expected to be completed within one month. During the trial period, all participants maintained their normal training status, with no changes in training or retraining menus, and no over-training or extra competitions.

Participants

In this study, 15-25 trained bodybuilders were recruited. All participants had more than 6 years of professional bodybuilding training and had participated in national bodybuilding competitions with adequate pre-competition dehydration experience. Inclusion criteria were: 1. having won the top 8 places in a national competition, 2. having no cardiovascular or joint diseases, and 3. being an adult male. Exclusion criteria were: 1. no top 8 finishes at national level; 2. cardiovascular or joint disease, or any other condition that could be impaired by exercise; 3. female and underage participants; 4. previous caffeine allergy. This study received approval from the Institutional Review Board of Jen-Ai Hospital - Dali Branch (202300071B0). This study was conducted following the Declaration of Helsinki.

Protocol

Pre test

Prior to the main experiment, all participants underwent a 15-minute sub-maximal exercise intensity test to understand the relationship between exercise intensity and heart rate, energy expenditure, fat expenditure, and carbohydrate consumption. The

methodology of this study has been used in the literature in the past(11). After wearing a heart rate monitor (RS800; Polar Electro Oy, Kempele, Finland), participants rested for 10 minutes in a standing position and heart rate values were obtained while standing. Next, participants were placed on a gas analyzer (Vmax Series 29C, Sensor Medics, CA, USA) and tested at different speeds of 1, 2, 3, 4, and 5 miles per hour on a 0-degree incline for 3 minutes each. Heart rate and energy expenditure during exercise were recorded for subsequent studies.

Experimental procedure

All experiments were scheduled to begin at 9:00 am. Upon arrival at the laboratory, participants will first have their urine (specific gravity) measured using a hydrometer (AAnalyst 800, Perkin Elmer, Waltham, MA) to record whether they are sufficiently hydrated (specific gravity < 1.020). Participants with a specific gravity > 1.020 were provided with 500 mL of bottled water to drink for 15 minutes prior to the start of the test until adequate hydration was achieved. Such an experimental procedure for dehydration has been used in previous studies (12).

When participants reached the same hydration state, they were fitted with a heart rate monitor (RS800; Polar Electro Oy, Kempele, Finland) and chewed either caffeine gum (5 mg/kg for 5 minutes per chew) or a placebo (5 minutes per chew, using regular gum). Take a 15-minute break after chewing and perform a brief warm-up and stretching. It was expected that the exercise environment would be set at 30°C and 50% humidity using air conditioning. After the warm-up, participants were free to adjust the resistance and speed of the bike according to their own feelings by riding the bike, and they were free to arrange the rest time. After 30 minutes of riding, the weight of the participant was measured every 10 minutes until dehydrated to 2% of their original body weight. The time from exercise to dehydration was recorded, and energy

expenditure, fat oxidation rate, and carbohydrate oxidation rate were calculated from the regression curve. At the end of the exercise, urine samples were collected again to analyze the data.

Caffeine and placebo gum

The caffeinated chewing gum (Military Energy Gum, Arctic Mint flavor; Stay Alert, Chicago, USA) and placebo used in this study were the same as previous study (13). All gums were crushed, ground, blended and reshaped, and flavored with 0.3 g of peppermint flavoring powder to ensure that their appearance, color, taste, weight and size were similar to the original gum. After chewing the gum, the participants completed a questionnaire to verify whether they could distinguish between the two types of gum.

Statistical analysis

The data in this study are presented as mean ± standard deviation. The Shapiro–Wilk test was used to examine the normality of the data. When normality distribution was reached, energy expenditure, dehydration rate, and urine specific gravity between the two groups were analyzed using the paired-sample t-test. If the normative distribution was not reached, it was analyzed using the Wilcoxon sign rank. Significant levels were set at $\alpha < 0.05$.

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