EFFECTS OF CARBONATED AND NONCARBONATED BEVERAGE INTAKES IN RESPONSE TO PROLONGED CYCLE ERGOMETER EXERCISE

TAEWOONG OH¹), MITSURU HIGUCHI¹), KAZUYUKI KANOSUE¹),
CHIYOKO USUI²), ISAO MURAOKA¹), SHIZUO SAKAMOTO¹),
IKUO SHIBUICHI³) and HIROMICHI MITSUDA³)

Abstract

Athletes have been instructed to refrain from taking carbonated beverages in the sports world, but the mechanism has not been clear. The purpose of this study was to clarify how physiological and biochemical evaluation are affected by taking a 10% CHO carbonated beverage after cycle ergometer(60 min, 60% $\dot{V}O_2\text{max}$). Seven subjects consumed a carbonated or noncarbonated (10% carbohydrate)beverage after exercise. No differences were observed in concentration of glucose, insulin, free fatty acids, K and Na in serum from carbonated beverage compared with noncarbonated beverage intakes after exercise.

These results indicate that carbonated beverage did not affect the changes of physiological and biochemical parameter after prolonged exercise, and it could be more refreshing and stimulate taste rather than noncarbonated beverage, but seemed to be hard to drink immediately after exercise because it made subjects feel as if having drunk more than they did.

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key word : body temperature, blood glucose, carbonated beverage intake, exercise

Introduction

Prolonged exercise can result in dehydration, decreasing body weight by even 1 % is sufficient to impair thermoregulation and subsequent exercise performance^{1~3}). Many beverages have been formulated to replenish fluid losses during exercise as well as to potentially enhance athletic performance⁴).

Carbonated beverages, are effervescent drinks that releases carbon dioxide under conditions of normal atmospheric pressure⁵). Carbonation may occur naturally in spring water that has absorbed carbon dioxide at high pressures underground. It can also be a byproduct of fermentation, such as beer and some wines.

The purpose of this study was to clarify how body temperature, serum glucose level and taste are affected by taking carbonated beverage include 10% CHO after cycle ergometer through physiological and biochemical evaluation.

Methods

Subjects

Seven healthy male college students volunteered for this crossover study approved by Waseda University ethics committee. Subject details(mean $\pm$ standard deviation) were as follows age 22.5 ± 0.9 years, height 173.1 ± 6.5 cm, body mass 69.4 ± 6.3 kg, BMI 23.1 ± 1.4 kg/m², fat mass 17.9 ± 4.5 kg and $\dot{V}O_2\text{max}$ 3.04 ± 0.25 l/min/kg. The subjects had taken part in a previous(2 wk prior)reliability investigation during which subjects undertook incremental tests to exhaustion on a electromagnetically braked cycle ergometer(818 & ERGOMEDIC, MONARK)which quantified subjects maximal oxygen consumption($\dot{V}O_2\text{max}$)and maximum heart rate(HRmax)

Procedure

Subjects were instructed to refrain from physical activity for 24 h prior to experiments and not to consume caffeine or alcohol-containing fluids the day

¹)Faculty of Sport Sciences, Waseda University

²)Graduate School of Human Sciences, Waseda University

³)Beverage Research & Development Laboratory, Asahi Soft Drinks Co., Ltd.

prior to trials. Subjects were provided with a checklist to complete as they ate their provisions including a section to note any variations from the questionnaire survey provided.

Subjects were provided with a breakfast(a piece of banana, 250 ml milk, 150 g steamed rice, a boiled egg ; 572 kcal)approximately 2 h prior to the commencement of the trials. The trials were conducted in environmentally stable conditions(Average room temperature : $25 \pm 1^\circ\text{C}$, humidity : 50%)

Subjects were informed that an intensity of approximately 60% $\dot{V}\text{O}_{2\text{peak}}$ was recommended for optimal 1 h cycling performance. A Blood sample was taken at the completion of trial.

Beverages

After exercise subjects received 500 ml of carbonated(about a fourfold volume of carbon dioxide com-

pared to content fluid was dissolved)or noncarbonated beverage which contained 10% carbohydrate. They drank mineral waters(200 ml)2 hours after breakfast, and exercised for an hour after weighting.

Anthropometry Measurements

Body weight was measured with light indoor clothing without shoes to the nearest 0.1 kg using electronic scales(calibrated at the beginning of the study by the manufacturer). Height was measured without shoes to the nearest 0.1 cm on a stadiometer. Body mass index(BMI)was calculated as $\text{weight}/\text{height}^2$ (kg/m^2)

Statistics

Data are expressed as mean $\pm$ SEM. The statistical significance($p < 0.05$)of differences was determined with a one-way analysis of variance(ANOVA)followed by a Fisher PLSD post-hoc analysis.

Figure 1. Serum glucose(mg/dl), insulin(U/ml), FFA(mEq/dl)versus time(min)during the ad libitum drinking experiments. Subjects voluntarily consumed either a 10% carbonated or noncarbonated drink during 1 hour of prolonged cycle ergometer exercise(60% $\dot{V}\text{O}_{2\text{peak}}$). Values are mean $\pm$ SE. *Significantly different from before exercise($p < 0.05$)

Results

Figure 1 details the effects of the carbonated beverage taken after exercise on serum glucose, insulin, FFA. There were no significant differences in the biochemical parameters during the recovery phase between drink consumption of carbonated and noncarbonated. Figure 2 details the effects of the carbonated beverage taken after exercise on serum K and Na. There were no significant differences in serum K and Na concentrations between carbonated and noncarbonated consumption. Table 1 shows the

mood of carbonated beverage taken after exercise by comparing with noncarbonated beverage intake. The carbonated beverage was better in terms of refreshment ($p < 0.05$) and stimulating ($p < 0.01$) taste compared to the noncarbonated beverage, but seemed to be hard to drink all at once ($p < 0.01$) because it made subjects feel as if having drunk more than they did ($p < 0.05$).

Discussion

The main findings of this study were that 1) intake of a carbonated beverage after prolonged exer-

Figure 2. Serum K (mEq/L) and Na (mEq/L) versus time (min) during the ad libitum drinking experiments. Subjects voluntarily consumed either a 10% carbonated or noncarbonated drink during 1 hour of prolonged cycle ergometer exercise ($60\% \dot{V}O_{2peak}$). Values are mean $\pm$ SE. *Significantly different from before exercise ($p < 0.05$).

Table 1. Mood of carbonated beverage taken after exercise.

Yes: 5 score ↔ No: 1 score			
	Uncarbonated	Carbonated	t-test
Refreshment	3.13	4.25	*

Subjects voluntarily consumed either a 10% carbonated or noncarbonated drink after 1 hour of prolonged cycle ergometer exercise ($60\% \dot{V}O_{2max}$). Values are mean $\pm$ SE. *, ** significantly different from noncarbonated drink ($p < 0.05$, $p < 0.01$).

cise did not affect the levels of serum glucose, insulin, free fatty acid, K and Na during the recovery phase compared to the noncarbonated beverage intake, 2)sensory assessment showed that the carbonated beverage was better in terms of refreshing and stimulate taste compared to the noncarbonated beverage, but seemed to be hard to drink all at once because it made subjects feel as if having drunk more than they did.

The primary goal of fluid replacement during exercise is to prevent dehydration and hyperthermia. A secondary goal is to supply an exogenous carbohydrate source for the liver and contracting skeletal muscle. Voluntary dehydration commonly occurs during exercise⁶). In this study, voluntary dehydration occurred during 60 minutes of cycle ergometer exercise and resulted in substantial body fluid deficits ranging from 2.3 to 2.9% of body weight. The relative effect of two stressful conditions(hypohydration, exercise)on voluntary fluid intake has been documented^{7,8}). In the present study, comparison of carbonated and noncarbonated drinks did not reveal significant differences for the levels of serum glucose, insulin, free fatty acid, K, Na or percentage of body weight loss.

In summary, the presence of carbonation in a 10% carbohydrate drink did not influence physiological and biochemical evaluations or that the carbonated beverage was better in terms of refreshment and stimulating taste compared to the noncarbonated beverage,

but seemed to be hard to drink all at once because it made subjects feel as if having drunk more than they did after prolonged cycle ergometer exercise.

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