

# The effects of different beverage intake on blood components during exercise under high-temperature environment

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High temperature environment causes detrimental effects on health. In the present study, the effects of intake of several kinds of beverage on blood components during exercise under the high temperature environment were evaluated. The 10 subjects were student of the H University. Exercise intensity was 50-60%  $O_{2max}$  and treadmill exercise was continued for 1 h. The kinds of beverage were water, ion beverage, cucumber drink. Blood sampling was performed before the exercise, immediately finishing exercise, and 30 min after rest. In the present results, glucose concentration was increased by intake of water, ion beverage, and cucumber drink immediately after exercise. In the water intake group, glucose concentration was decrease 30 min after rest. Free fatty acid concentration was increased by intake of water, ion beverage, and cucum-

ber drink 60 min after exercise. In the ion beverage and cucumber drink intake groups, free fatty acid concentration was decreased 30 min after rest. Insulin concentration was increased by intake of water, ion beverage, and cucumber drink 60 min after exercise. In the water intake group, insulin concentration was decrease 30 min after rest. There was no difference in the efficacy among water, ion beverage, and cucumber drink, but ion beverage and cucumber drink showed more potent effect on metabolic parameters.

**Keywords:** Glucose, Free fatty acid, Insulin, High temperature conditions, Beverage intake

## INTRODUCTION

High temperature environment causes detrimental effects on health. Especially, exercise under the high temperature conditions causes adverse effects on body. If a man performs exercise under the high temperature conditions, sweating is increased to prevent over-rise of body temperature. Through this process, a man becomes dehydration state, and then exercise performance is reduced (Reilly et al., 2006).

Quod et al. (2006) suggested the importance of strategy how the athletics can exhibit their maximum power under the high temperature conditions. Continuous rehydration is important factor for the continuous exercise under the high temperature conditions, because 3% weight loss and 1.5 L water loss are accompanied with the continuous exercise under the high temperature

conditions (Davis et al., 2001).

In the present study, the effects of intake of several kinds of beverage on blood components during exercise under the high temperature environment were evaluated.

## MATERIALS AND METHODS

### Participants

The 10 subjects were student of the H University. Their major was exercise and had no physical and mental problems. They participated in this study after allowing the process and treatment. The physical characteristics of subjects are shown in Table 1.

### Experimental procedure

The conditions of exercise chamber were 38-40°C temperature

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**Table 1.** Physical characteristics of subjects

Items	Age (yr)	Height (cm)	Weight (kg)	Skeletal muscle (kg)	Fat (kg)	% Body fat (%)
Subject (n = 10)	22.50 ± 1.58	174.52 ± 2.75	68.22 ± 5.59	34.64 ± 3.21	60.12 ± 4.24	15.59 ± 2.48

Values are mean ± SD.

**Table 2.** Parameters

Factors	Groups	Before	After	Rest	2-way mixed ANOVA		P
Glucose (mg/dL)	Water	88.00 ± 1.54	99.00 ± 14.77	91.33 ± 8.31	Time	F	5.287*
	Ion	97.83 ± 5.98	123.83 ± 17.05	141.16 ± 15.06	Time*Kind		0.266
	Cucumber	99.83 ± 2.48	121.50 ± 10.03	131.16 ± 23.94	Group		16.056**
Free fatty acid (μEq/L)	Water	460.66 ± 25.76	883.66 ± 85.89	1,075.66 ± 43.51	Time	F	15.414**
	Ion	434.33 ± 26.95	1,068.66 ± 48.46	369.50 ± 22.84	Time*Kind		2.234
	Cucumber	422.16 ± 32.76	1,110.83 ± 61.60	460.66 ± 19.27	Group		0.392
Insulin (μU/mL)	Water	5.13 ± 2.53	9.83 ± 6.11	4.40 ± 1.12	Time	F	0.352
	Ion	8.81 ± 3.36	19.74 ± 14.52	34.21 ± 20.84	Time*Kind		2.926
	Cucumber	8.62 ± 2.69	13.40 ± 4.41	20.27 ± 8.67	Group		5.293*

Values are mean ± SD. \* $P < 0.05$ . \*\* $P < 0.001$ .

and 60-70% humidity. Exercise intensity was 50-60%  $O_{2max}$  and treadmill exercise was continued for 1 h.

### Beverage intake

The intake of beverage was repeated 4 times: 30 min before starting exercise, 20 min and 40 min after starting exercise, and immediately after cessation of exercise. The kinds of beverage were water (C company), ion beverage (G company), cucumber drink (Z company).

### Blood sampling and analysis

Blood sampling was performed before the exercise, immediately finishing exercise, and 30 min after rest. Glucose was detected by glucose oxidation method, free fatty acid was detected by immunoassay, and insulin was detected by radio-immune assay.

### Data analysis

Statistical analysis was conducted using SPSS 18.0, and two-way repeated ANOVA was conducted. Statistical significance was set at  $P < 0.05$ .

## RESULTS

The results are presented in Table 2. In the glucose concentration, there was statistical significance with the groups ( $F = 16.056$ ,  $P = 0.001$ ), and intake time ( $F = 5.287$ ,  $P = 0.036$ ), however there was no significance in the kinds of beverage ( $F = 0.266$ ,  $P = 0.770$ ) with the glucose concentration.

In the free fatty acid concentration, there was statistical significance with the intake time ( $F = 15.414$ ,  $P = 0.001$ ), however there was no significance in the groups ( $F = 0.392$ ,  $P = 0.682$ ) and kinds of beverage ( $F = 0.2234$ ,  $P = 0.142$ ) with the free fatty acid.

In the insulin concentration, there was statistical significance with groups ( $F = 5.293$ ,  $P = 0.018$ ), however there was no significance with kinds of beverage ( $F = 0.352$ ,  $P = 0.562$ ) and intake time ( $F = 0.2926$ ,  $P = 0.085$ ).

## DISCUSSION

Exercise-induced dehydration deteriorates exercise performance and hyponatremia by long-term exercise also causes harmful effect on exercise performance (Hiller, 1989; Noakes et al., 1985). In order to decrease core temperature, intake cold water or cold beverages are recommended. Usage of glucose is dependent on the exercise intensity and insulin concentration (Costill et al., 1973).

In the present study, glucose concentration was increased by intake of water, ion beverage, and cucumber drink immediately after exercise. In the water intake group, glucose concentration was decrease 30 min after rest. Free fatty acid concentration was increased by intake of water, ion beverage, and cucumber drink 60 min after exercise. In the ion beverage and cucumber drink intake groups, free fatty acid concentration was decrease 30 min after rest. Presently, insulin concentration was increased by intake of water, ion beverage, and cucumber drink 60 min after exercise. In the water intake group, insulin concentration was decrease 30 min after rest.

High intensity exercise causes increment of glucose concentration (Geor et al., 2000) and submaximal intensity exercise causes increment of glucose concentration 30 min after exercise (Flynn et al, 1990). Insulin is known to increase free fatty acid mobilization and enhances glucose dependence of muscle.

Through this study, there was no difference in the efficacy among water, ion beverage, and cucumber drink, but ion beverage and cucumber drink showed more potent effect on metabolic parameters. These results suggest the possibility that ion beverage and cucumber drink are effective method for the athletics under the high temperature conditions.

## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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