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Effects of Dried Persimmon Snacks on Alcohol Metabolism in Men

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Abstract

Persimmon has been known to help alcohol intoxication in Korea for a long time and is prepared as a processed food. The effect of dried persimmon snacks on alcohol metabolism was determined *in vivo*. Eight Korean men (25~27 years old) were administered 3.5 mL/kg of alcohol (22.5%, w/v) with or without a dried persimmon snack (2 g/kg). The levels of alcohol in the blood and of acetaldehyde in the blood and the urine were determined by alcoholmeter and assay using alcohol dehydrogenase and HPLC, respectively. All subjects showed decreased levels of alcohol in blood, and six subjects showed a decrease of alcohol in urine after consumption of ethanol with dried persimmon snacks. Concentration of acetaldehyde in the blood and urine decreased significantly in three and five of the eight subjects, respectively. Reduction was more significant for alcohol than for acetaldehyde with administation of ethanol and dried persimmon snacks. This *in vivo* result suggests that dried persimmon snacks are effective in decreasing the concentration of alcohol after alcohol intake.

Key words: persimmon, alcohol metabolism, alcohol, acetaldehyde

INTRODUCTION

An excess intake of alcohol causes hangover symptoms like headache and discomfort, although drinking in moderation may not be harmful (1,2). These symptoms could be due to the effects of ethanol metabolites such as acetaldehyde, acetate, and ketone bodies (3-5). Acetaldehyde, the first metabolite in ethanol metabolism, plays an important role in alcohol toxicity in humans. Many studies have dealt with detoxification effects of herbal medicine, amino acids, and food stuff in treatment of acute alcoholism (6,7). Persimmon is one fruit which is loved in most oriental countries such as Korea, Japan, and China. It also has been considered to have a therapeutic value for various diseases. Alleviation of discomfort from excessive alcohol ingestion by taking persimmon has been known for a long time in Korea. However, its efficacy was not demonstrated scientifically. A processed food, dried persimmon snacks, from sweet persimmons were prepared to increase consumption of fruit and storage. We attempted to show the efficacy of dried persimmon snacks in facilitating alcohol metabolism in humans.

MATERIALS AND METHODS

Materials

Sweet persimmon and distilled liquor were purchased from a local supermarket in Ulsan, Korea. Aldehyde, thiourea, EDTA, DNP hydrazine, Na_2SO_4, glycine, NAD, yeast alcohol dehydrogenase were purchased from Sigma Co. (St. Louis, MO, USA).

Study subjects

Eight Korean adult males were selected as healthy subjects using the following criteria: 1) aged 25~27 years: 2) no present disease or medical treatment. They consumed 3.5 mL/kg of Soju, the most popular Korean alcohol beverage (22.5% alcohol) without taking breakfast, with or without a dried persimmon snack (2 g/kg). The level of alcohol in the blood was determined by Lion alcohol meter SD-400 (Lion Laboratory, UK). Blood was collected from their forearm veins before drinking, and at indicated time points after drinking alcohol. Urine was also collected at the same time points. To determine the concentrations of ethanol and acetaldehyde, 1 mL each of blood and urine were deproteinized with 2.5 mL of PCA reagent (0.6 N perchloric acid, 30 mM thiourea, and 0.1 mM EDTA in saline). After centrifugation at 3,000×g, the supernatant was transferred and titrated for the following assays.

Preparation of dried persimmon snacks

Sweet persimmon was processed to make dried persimmon snacks. Fruits were washed, sliced with 2~4 mm width. The pieces were steeped in 10% sugar solution, boiled for 10 min, and soaked for 24 hr. Persimmon pieces were taken from the sugar solution and washed with water for 5 sec to remove extra sugar solution. The final product was stored to protect it from moisture after freeze-drying.

Determination of acetaldehyde

Aetaldehyde concentration was determined by modification of the method of Park et al. (8). A 0.5 mL deproteinized sample was treated with 0.01 M DNP hydrazine in 3.6 M HCl and mixed for 30 min at room temperature. The organic phase was separated and washed three times with 10 mL water after

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adding 20 mL of n-hexane. The remaining trace amount of water was removed by anhydrous Na_2SO_4. The organic phase was separated and the solvent was evaporated to dryness by vacuum rotary evaporator (Brinkmann). The concentrate was dissolved in 1 mL of CH_3CN : water (50:50, v/v) and analyzed by HPLC with a column (μBondapak C_{18}, 10 μ, Waters). A UV detector was set at 356 nm for the detection of acetaldehyde DNP hydrazone.

Determination of alcohol by alcohol dehydrogenase activity

Blood and urine alcohol levels were determined by yeast alcohol dehydrogenase (Sigma Chemical Co., USA) using ethanol as a standard. The assay contained 50 mM glycine buffer, pH 9.5, 1 mM NAD, 1 ug yeast alcohol dehydrogenase, and each deproteinated sample. Alcohol dehydrogenase activity was determined by measurement of substrate-dependent reduction of NAD. NADH was measured by spectrofluorimetry (excitation, 350 nm; emission, 460 nm) (Pharmacia Co., Sweden) (9).

RESULTS AND DISCUSSION

Concentrations of alcohol in the blood and urine

Each person's blood alcohol level (Fig. 1) was determined by alcoholmeter and assay using yeast alcohol dehydrogenase (Fig. 2) at an indicated time point with or without taking a dried persimmon snack. Each person is described in Table 1. Blood alcohol was at its maximum level at 20~30 min, decreased as time continued and reached its lowest level at 300~350 min after drinking alcohol. The pattern of blood alcohol levels was similar in both methods of assay: yeast alcohol dehydrogenase and alcoholmeter. The concentrations of alcohol in the blood of all subjects treated with dried persimmon snacks was lower than those with only ethanol. The difference between

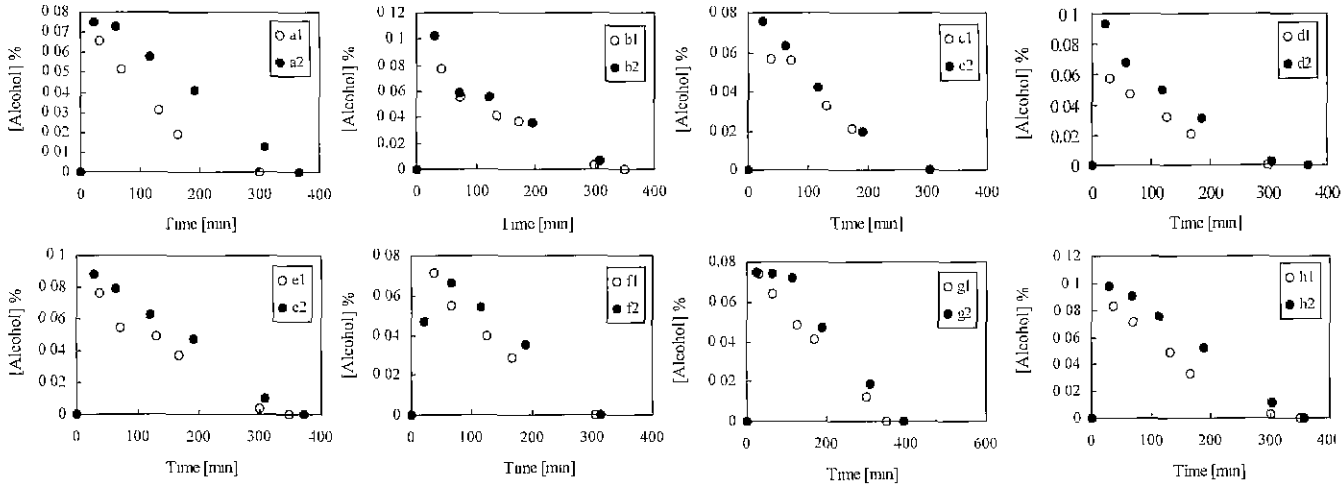

Fig. 1. The blood level of alcohol after alcohol consumption with or without intake of dried persimmon snack. Eight Korean male adults consumed 3.5 mL/kg of 22.5% alcohol with or without a 2 g/kg of dried persimmon snack. Each set was performed at two different days. Blood alcohol was determined by Lion alcohol meter SD-400 (Lion Laboratory, UK). ○: with intake of dried persimmon snacks, ● without intake of dried persimmon snacks.

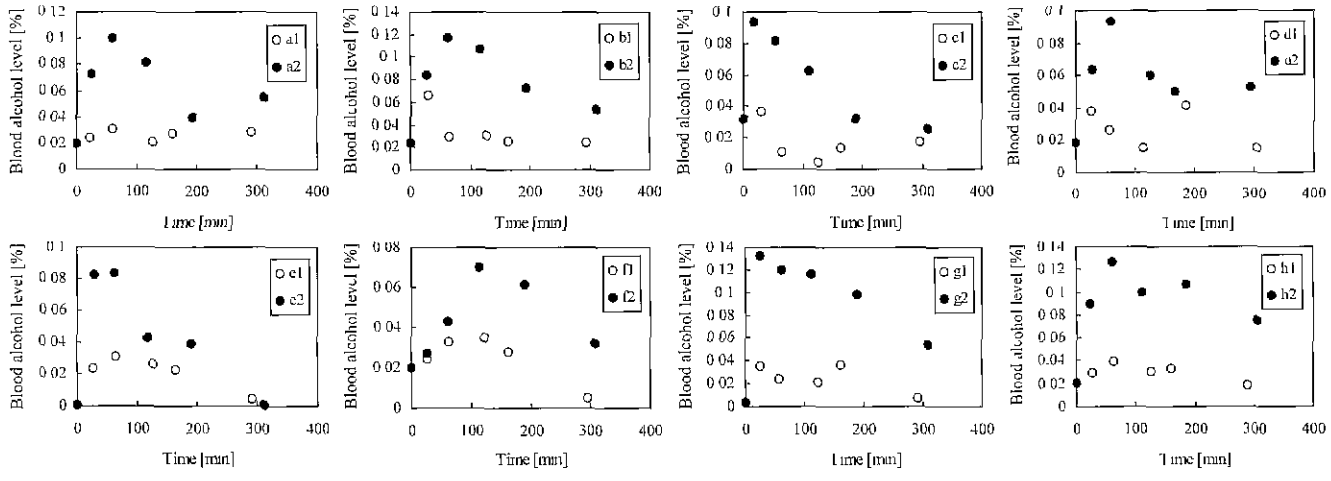

Fig. 2. The blood level of alcohol after alcohol consumption with or without intake of dried persimmon snacks. Eight Korean male adults consumed 3.5 mL/kg of 22.5% alcohol with or without 2 g/kg of dried persimmon snacks. Each set was performed at two different days. *Blood alcohol was determined by alcohol dehydrogenase assay. ○: with intake of persimmon, ●: without intake of persimmon*

the two conditions was much significant by assay with yeast alcohol dehydrogenase. When the urine alcohol level of each subject was measured, the maximum level of alcohol in the urine peaked later than that in the blood (Fig. 3). A significant decrease in alcohol concentration was found when alcohol was consumed with dried persimmon snacks in six of eight subjects. These results showed that dried persimmon snacks are effective to reduce the blood alcohol level after drinking. Since the concentration of sugar was determined to be 15% in dried persimmon snacks, the stimulating effect on alcohol

Table 1. Description of each person taking alcohol with or without a dried persimmon snack

Subject	Age	Weight (kg)	Height (cm)	Color of face	Usual amount of alcohol	Frequency	Period of Intoxication after alcohol	Symptom of hangover after alcohol consumption	Period of intoxication after alcohol+ persimmon
a	26	64	165	none	24% × 350 mL	2/7 days	2 hrs after	dizziness	2 hrs after
b	27	65	165	slightly flush	24% × 350 mL	1/7 days	5 hrs after	slight headache	5 hrs after
c	25	63	173	none	24% × 350 mL	2/7 days	7 hrs after	none	6 hrs after
d	26	65	172	none	24% × 350 mL	3/7 days	16 hrs after	none	16 hrs after
e	25	50	172	flush	24% × 180 mL	1/7 days	7 hrs after	severe headache	6 hrs after
f	25	75	173	none	24% × 530 mL	1/7 days	4 hrs after	severe headache	4 hrs after
g	25	62	168	flush	24% × 180 mL	1/7 days	4 hrs after	none	3 hrs after
h	25	77	173	slightly flush	24% × 530 mL	2/7 days	4 hrs after	headache	3 hrs after

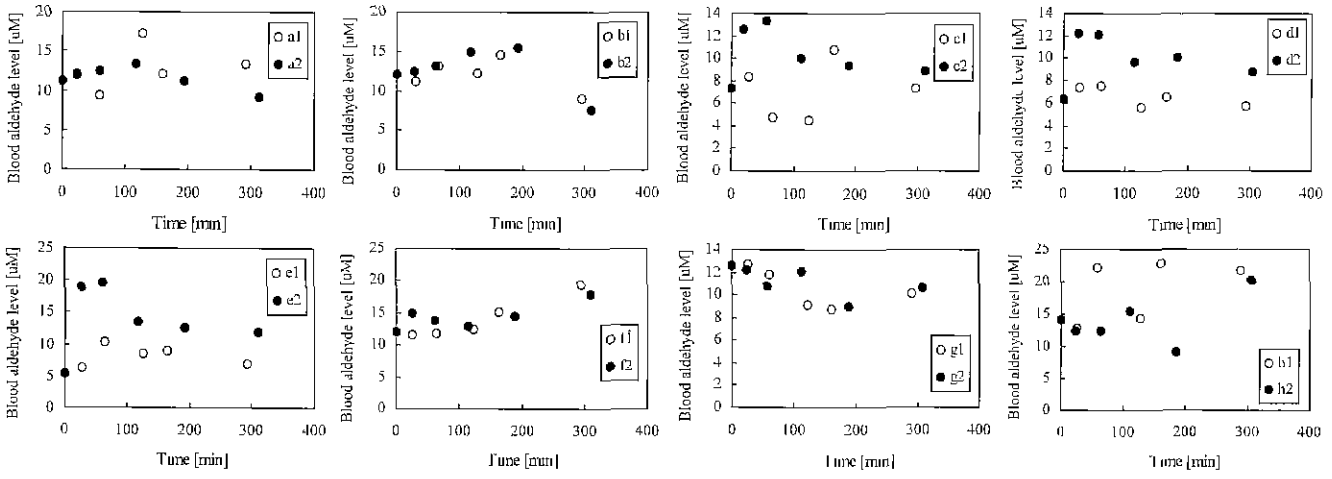

Fig. 3. The blood level of aldehyde after alcohol consumption with or without intake of dried persimmon snacks. Eight Korean male adults consumed 3.5 mL/kg of 22.5% alcohol with or without 2 g/kg of dried persimmon snacks. Each set was performed at two different days. Blood aldehyde was determined by the method of Park et al. (8). ○: with intake of persimmon, ●: without intake of persimmon

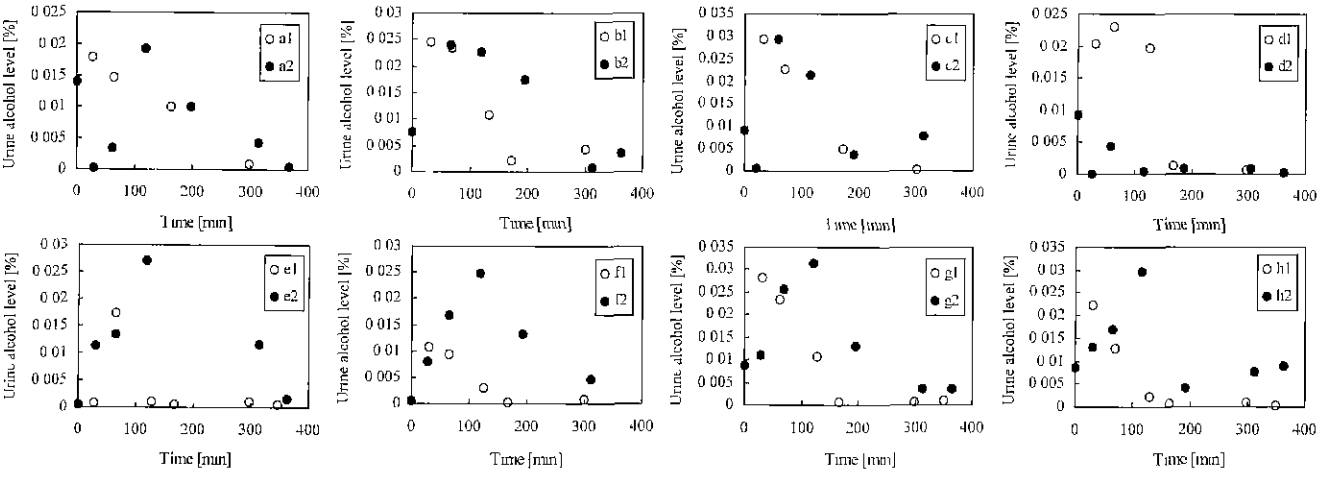

Fig. 4. The urine level of alcohol after alcohol consumption with or without intake of dried persimmon snacks. Eight Korean male adults consumed 3.5 mL/kg of 22.5% alcohol with or without 2 g/kg of dried persimmon snacks. Each set was performed at two different days. Urine alcohol was determined by alcohol dehydrogenase assay. ○: with intake of persimmon, ●: without intake of persimmon

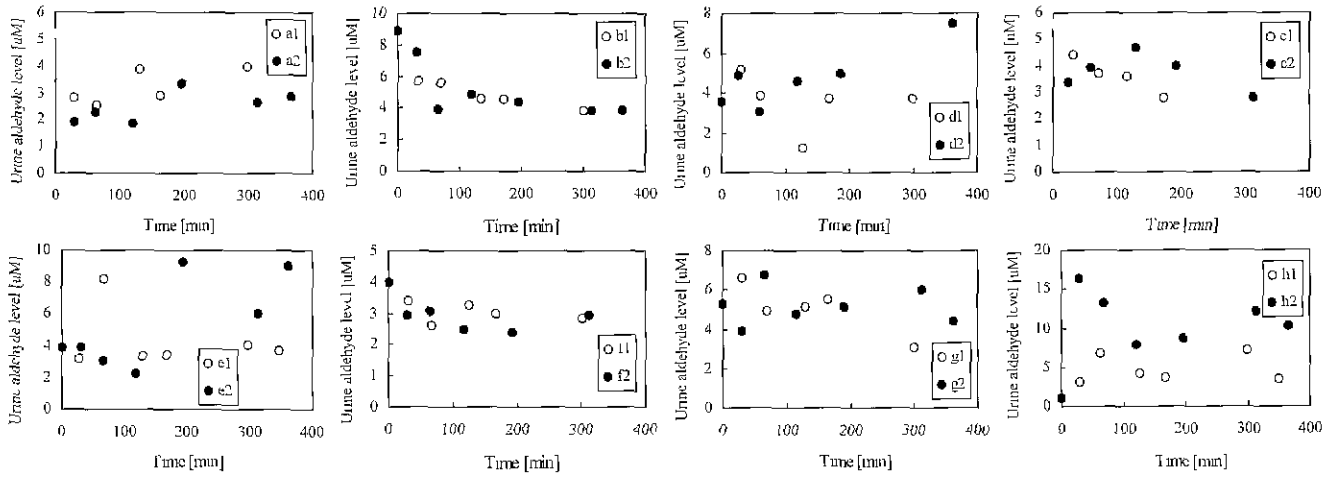

Fig. 5. The urine level of aldehyde after alcohol consumption with or without intake of dried persimmon snacks. Eight Korean male adults consumed 3.5 mL/kg of 22.5% alcohol with or without 2 g/kg of dried persimmon snacks. Each set was performed at two different days. Urine aldehyde was determined by the method of Park et al. (*8*). ○: *with intake of persimmon*, ●: *without intake of persimmon*

metabolism could be caused by persimmon and partly by sugar.

Concentration of acetaldehyde in the blood and urine

The change in the concentration of aetaldehyde in the blood depended on each subject as shown in Fig. 4. Decrease of aldehyde concentration was much lower than that of alcohol concentration when subject was treated with alcohol and dried persimmon snacks. Only three showed a significant decrease of aldehyde concentration with consumption of dried persimmon snacks, while one subject showed a slight decrease. No change of blood aldehyde concentration was found for two subjects. Higher concentration of blood aldehyde was observed for two subjects, though blood alcohol concentraion was reverse when taking dried persimmon snacks. The maximum level of aldehyde concentration in the urine was lower than that in the blood as shown in Fig. 5, indicating that a major amount of aldehyde was removed before excretion. Consumption of dried persimmon snacks resulted in a decrease of aldehyde concentration in the urine of 5 subjects. No change was found in two subjects. A higher level of aldehyde concentration was observed in one subject. The aldehyde level in the blood or urine was not significantly reduced, compared with the alcohol level. However, consumption of dried persimmon snacks resulted in lower alcohol concentrations in the blood and urine. Dried persimmon snacks could be effective for efficient alcohol metabolism in men. It could be a promising candidate for elimination of lingering alcohol intoxication.

ACKNOWLEDGEMENTS

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