

# 한국인에서 Aldehyde Dehydrogenase 2 유전자 변이가 알코올의 신경인지 기능, 정신운동성 수행 및 주관적 반응에 미치는 영향\*

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## Effects of Alcohol on Neurocognitive Function, Psychomotor Performance and Subjective Response in Koreans with Different ALDH2 Genotypes\*

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### ABSTRACT

**Objective :** The purpose of this study was to evaluate the effects of alcohol on neurocognitive function, psychomotor performance and subjective response in healthy Korean adults with different ALDH2 genotypes.

**Method :** A total of 24 males, half with active ALDH2\*1/2\*1 and the other with inactive ALDH2\*1/2\*2, was selected through genotyping using restriction fragment length polymorphism. In a double-blind, placebo-controlled cross-over design, each subject consumed 0.5g/kg dose of alcohol, given as a mixture of 40% vodka and orange juice, and placebo(orange juice) on two separate occasions on an average of weekly intervals. The blood alcohol concentrations(BACs) were measured using a breath analyzer at baseline and at 30, 60 minutes after drinking. P300s were measured at baseline and at 30 minutes after alcohol and placebo intake. Vital signs and psychomotor performance[Critical Flicker Fusion Threshold(CFFT), Choice Reaction Time (CRT), Digit Symbol Substitution(DSS)] were measured at baseline and at 60 minutes after alcohol and placebo intake. Subjective responses were measured at the end of the study. The statistical analysis focused on whether there were any differences between groups with different ALDH2 genotypes.

#### Results :

The major results are as follows.

- 1) BACs in the inactive group were overall equivalent to those in the active group. Only in terms of time, BACs were significantly higher overall at 30 minutes than at 60 minutes after alcohol intake.
- 2) Pulse rates were significantly increased after alcohol intake compared with placebo, and the increase was greater in the inactive than in the active group.
- 3) P300 latencies in leads Fz(frontal), Cz(central) and Pz(parietal) were significantly increased after alcohol intake compared to placebo, and the increase was greater in the inactive than in the active group. P300 amplitudes in leads Cz and Pz were significantly decreased overall after alcohol intake compared to placebo.
- 4) Compared with placebo, alcohol produced significant effect on the psychomotor performance : impairment in the inactive group, improvement in

1997

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the active group.

5) Compared with placebo, alcohol significantly induced a negative or an intense effect on the subjective responses in the inactive group, but little negative and even a somewhat positive effect in the active group.

**Conclusions :** These results suggest that ALDH isozyme variance might be an important factor to determine the effects of acute dose of alcohol on the various psychobehavioural functions and also to determine the alcohol use pattern and to predict the future development of alcohol overuse and/or abuse.

**KEY WORDS :** Alcohol · ALDH2 · P300 · Psychomotor performance · Subjective response.

(Higuchi 1992 ; Takeshita 1993) AL -

서 론

Wolff(1972) , 가 ALDH2가

가 가

alcohol dehydrogenase

(ADH) aldehyde dehydrogenase(ALDH) 가 (Agarwal 1981 ; Goedde 1983 ; Harada 1983, 1985 ; Higuchi 1992 ; Mizoi 1979 ; Nakawa-tase 1993 ; Ohmori 1986 ; Suwaki Ohara 1985), 가 ALDH2

(Chao 1995 ; Nakawatase 1993 ; Slutske 1995 ; Thomasson 1991 ; Wall Ehlers 1995).

ALDH2

(Harada 1985 ; Thomasson 1994).

30 50%가 (Hsu 1987 ; Thom- asson 1991). ALDH2 ALDH2 1996 ; 1995 ; 1992 ; 1998 ; (Hsu 1988 ; Lee 1997) , AL -

Yoshida 1984). DH2\*1/2\*1 59.3 84.0% 83.3 89.4%, ALDH2\*1/2\*2 22.9 33.3% 9.2 16.7%, ALDH2\*2/2\*2 3.0 7.4% 0 1.4% ALDH2

ALDH2 ALDH2\*1 ALDH2\*2 (genotype) 3가

ALDH2\*1/2\*1 ALDH2\*1/2\*2 ALDH2\*2/2\*2 ALDH2

가 (Crabb 1989 ; Goedde 1989 ; Wall Ehlers 1995). ALDH2\*2 ALDH2\*1 ALDH2

idehyde acetaldehyde가 , 1994), (Wall 1992), cortisol (Wall 1993), P300(Wall Ehlers 1995), ( 1996)

ALDH2\*2/2\*2 (Chao 1995 ; Cra- bb 1989 ; Goedde 1989 ; Higuchi 1991 ; Wall 1992). 가 ALDH2

가 . 4) 가 .

(event related ) 가 , 2)

potential) P300 1 , 3)

(Picton 1992), P300 ( , 4) 가

P300 (Campbell

1984 ; Lukas 1990 ; Rohrbaugh 1987 ; Teo Fer - 35

gusion 1986). ALDH2 P300 , ALDH2\*1/2\*1 21

Wall Ehlers(1995) ALDH2\*1/2\*2 14 .

P300 12 .

(Hindmarch 1982 ; Hindmarch 1991), ALDH2 ,

가 .

(1996) .

ethanol patch test ALDH2 .

## 2. 실험일정 및 알콜투여

Wall Ehlers(1995) (1996)

ALDH2 . 2 ,

ALDH2 1 . 가

가 , P300

20

5 30 10 .

ALDH2\*1 가

/2\*1 ALDH2\*1/2\*2 ,

2

## 연구대상 및 방법

### 1. 연구대상

, ( 1989), ,

- ( 1997) .

,

. 1) 19

25 , 2) -

가 27 40 , 3)

가 ,

**Table 1.** Subject's schedule of activities during each evaluation session

|         |  |
|---------|--|
| 17 : 30 | Arrival at laboratory  |
|         | History taking(including alcohol drinking, specific life events)                               |
|         | BACs(blood alcohol concentrations) & vital signs(pulse rate, blood pressure, body temperature) |
| 18 : 00 | Instruction and task battery practice  |
| 18 : 30 | Dinner   |
| 18 : 45 | Preparation for ERP(event related potential : P300)  |
| 19 : 45 | ERP  |
| 20 : 00 | Psychomotor performance test   |
| 20 : 15 | Ethanol(0.5g/kg) or placebo intake during 15 minutes   |
| 21 : 00 | BACs and ERP   |
| 21 : 30 | BACs & vital signs(pulse rate, blood pressure, body temperature)                               |
|         | Psychomotor performance test & subjective response questionnaire                               |

가 5 30

(blood alcohol concentrations : BACs)

가

Spielberger (1970)  
(1978)

가 20

(4) -  
가  
(a)

(Circadian rhythm questionn-  
aire)

8 15 15

5  
BACs

1/3  
30

1

BACs

13

가

Smith (1989)

( 1997).

13 55

41

, 26

, 27 40

40%

0.5g/kg

가

300ml

300ml

(5)

(Questionnaire for alcohol se-  
nsitivity)

가

4

가

가

Pollock

### 3. 평가도구 및 방법

(Pollock 1986)

, 6

#### 1) 선별검사 도구

#### 2) ALDH2 유전자형 분류(ALDH2 Genotyping)

(1) (Questionnaire for alcoholhabit)

DNA

TaKaRa

Dr. GenTLE kit

. 0.1ml

I

, DSM - (American Psychiatric Association  
1994)

( 1991 ; Ohmori 1986 ; Wi-

lkin Fortner 1985).

II  
III 가 DNA

isopropanol 가 DNA

(2) (Minnesota Multiphasic Personality In-  
ventory : MMPI)

가 가

Amplification created restriction site(ACRS)

sense primer antisense primer Harada Zhang(1993)

Genosys

. Primer

(1989)

566

Sense Primer : 5' - CAA ATT ACA GGG TCA AGG  
GCT - 3'

Antisense Primer : 5' - CCA CAC TCA CAG TTT TCT  
CTT - 3'

(3) - (State - Trait Anxiety Inventory :  
STAI)

Antisense primer

가

3'

21 - mer

. primer

3' 4 mismatch MbolI S2 S1 4 S2 1 가  
, polymerase chain reaction(PCR) S2 . 50  
DNA wild type , 250msec  
MbolI 가 . PCR 500msec 가 P300  
1ul DNA(20 50ng), 5ul 10x PCR buffer(100 Fz(frontal), Cz(central), Pz(parietal)  
mM Tris - HCl, 25mM MgCl<sub>2</sub>, 500mM KCl[pH 8.3]), P300  
50pmole primer, 1.25unit Taq polymerase(Boehringer msec ,  
Mannheim GmbH), 10mM deoxyribonucleic acid 1ul (baseline - to - peak amplitude)  $\mu$ V . P300  
50ul . Perkin Elmer  
GeneAmp PCR system 2400 94 4  
denaturation , 94 30 denatur - (2) Critical Flicker Fusion Threshold(CFFT)  
ation, 51 30 annealing, 72 30 exten - CFFT  
sion 30 . 72 5 (Hind -  
PCR DNA Sambrook (1990) march 1982 ; Hindmarch 1990, 1991). Leeds  
5% polyacrylamide gel . (diode) 1m 4  
ethidium bromide DNA UV  
wild type MbolI 125bp 가 (ascending  
DNA wild type (critical fus -  
135bp . band het - ion threshold) ,  
homozygotes band het - (desc -  
erozygotes 125bp 135bp band band (criti -  
cal flickering threshold)  
3) 혈중알콜농도(Blood Alcohol Concentrations : BACs) 3 ,  
Alco - Sensor (Intoximeters, Saint Lo - 가 Hz . 가  
uis) 가 가

4) 활력징후(Vital signs) (3) Choice Reaction Time(CRT)  
CRT - (Hindmarch  
1988 ; Young 1970). Leeds Psychomotor Te -  
stor(LPT)(Laflaf Electronics, Surrey) . LPT

5) 인지 및 정신운동성 수행  
(1) P300 50cm  
(event related potential) P300 ton) 가 (base - line but -  
(Romani 1987 ; Roth 1981). 가 6  
(Brain Atlas version 2.35 Model 688 Bio - 가  
Logic System Corp. Copyright 1992) .  
P300 (auditory stimuli) od - (recognition reaction time : RRT), 가  
dball procedure . 가 (S1, S2) (movement reaction time :  
, S1 1,000Hz, 70dB , S2 2,000Hz, MRT), 가 (total reaction  
70dB tone . S1 time : TRT) msec .  
S2 . S1

(4) Digit Symbol Substitution Test(DSST)

(Glosser 1977, Lezak 1995). DSST (Korean - Wechsler Adult Intelligence Scale : K - WAIS ; 1992)

(p<.05).

(facial flushing)(p

90

(2) - (4) 3가 (battery)

(2) (4)

10

6) 주관적 반응에 관한 설문지(Questionnaire for subjective response)

12

Michigan

Alcohol Screening Test(Selzer 1971) (1991 ; Mizoi 1983 ; Ohmori 1986 ; Pollock 1986 ; Schuckit 1984 ; Wolff 1972)

4. 자료분석

<sup>2</sup> test( Fisher's exact test) t - test

ALDH2

가

(two - way repeated measures ANOVA)

, P300, ( )

(ALDH

) . BACs

(30 60 )

p<.05

SPSS 8.0 for windows

결 과

1. 사회인구학적 특성

ALDH2

( 2).

2. 음주력, 음주습관 및 평소 음주 후 알콜민감성

ALDH2

**Table 2.** Demographic characteristics in ALDH2\*1/2\*1 and ALDH2\*1/2\*2 groups

| Characteristics                                    | ALDH2*1/2*1 (N=12) | ALDH2*1/2*2 (N=12) | P  |
|--|--------------------|--------------------|----|
| Age(Yr)  | 21.75 ± 2.01       | 22.67 ± 2.27       | NS |
| Place of birth(No)                                 |                    |                    | NS |
| Urban  | 6                  | 7                  |    |
| Rural  | 6                  | 5                  |    |
| Trait anxiety(score) <sup>a</sup>                  | 40.58 ± 6.16       | 40.50 ± 6.11       | NS |
| Circadian rhythm questionnaire(score) <sup>b</sup> | 35.25 ± 3.77       | 36.92 ± 3.34       | NS |

a : Assessed with Spielberger's Trait Anxiety Scale.

b : Assessed with Korean version of morningness-eveningness questionnaire.

**Table 3.** Comparison of alcohol drinking history, habits and alcohol sensitivity in ALDH2\*1/2\*1 and ALDH2\*1/2\*2 groups

| Variables  | ALDH2*1/2*1 (N=12) | ALDH2*1/2*2 (N=12) | P     |
|--|--------------------|--------------------|-------|
| Drinking history   |                    |                    |       |
| Age of beginning(Yr)                                       | 18.33 ± 1.30       | 18.17 ± 1.53       | NS    |
| Experience of black out(No)                                |                    |                    | NS    |
| Yes  | 4                  | 3                  |       |
| No   | 8                  | 9                  |       |
| Age at onset of black out                                  | 19.75 ± 2.06       | 9.67 ± 2.08        | NS    |
| Drinking habits  |                    |                    |       |
| Frequency per month(No)                                    | 7.25 ± 4.25        | 5.83 ± 3.64        | NS    |
| Preference of alcohol(No)                                  |                    |                    | NS    |
| Light liquor   | 8                  | 10                 |       |
| Hard liquor  | 4                  | 2                  |       |
| Average amount per drinking(bottle <sup>a</sup> )          |                    |                    |       |
| Beer   | 2.21 ± 1.17        | 1.45 ± 0.63        | NS    |
| Soju   | 0.98 ± 0.39        | 0.66 ± 0.31        | <.05  |
| Maximal amount per drinking(bottle <sup>a</sup> )          |                    |                    |       |
| Beer   | 4.88 ± 1.55        | 3.73 ± 1.71        | NS    |
| Soju   | 2.06 ± 0.77        | 1.67 ± 0.80        | NS    |
| Alcohol sensitivity in physiological response <sup>b</sup> |                    |                    |       |
| Facial flushing  | 2.33 ± 1.30        | 4.58 ± 1.08        | <.001 |
| Chest palpitation  | 1.17 ± 1.47        | 3.00 ± 1.86        | <.05  |
| Dizziness  | 2.08 ± 1.78        | 3.00 ± 1.60        | NS    |
| Headache   | 1.50 ± 1.24        | 2.92 ± 1.68        | <.05  |
| Nausea/vomiting  | 1.33 ± 1.23        | 3.25 ± 1.60        | <.05  |
| Sleepiness   | 2.92 ± 1.56        | 4.25 ± 1.48        | <.05  |

a : The volume for a bottle of beer was 500ml, while it was 300ml for soju. Soju is a Korean alcohol similar to Vodka and contains 25% of alcohol per volume.

b : Each item was rated on a 0 - 6 point scale. 0 denotes 'not at all' and 6 denotes 'extremely severe'.

<.001), (chest palpitation)(p<.05), (headache) (p<.001) (p<.001).  
 (p<.05), / (nausea/vomiting)(p<.05), (sleepin - Fz , Fz  
 ess)(p<.05) , (dizziness) 가 ( 3). 가

### 3. 혈중 알콜농도

BACs (main effect)(p<.05) Cz (p<.05), (p<.01).  
 , BACs 30 60 Cz (p<.001) (p<.01)  
 ( 4). Cz

### 4. 활력징후

(p<.05), 가 Cz  
 (p<.05) Pz (p<.001)  
 (p<.05). 가 (p<.01)  
 ( 5). Pz (p<.05)  
 Pz

### 5. 인지 및 정신운동성 수행

P300 6 7 가 Pz  
 1) P300 2) CFFT  
 Fz CFFT (p<.01)  
 (p<.05), (p<.01)

**Table 4.** Blood alcohol concentrations(BACs : mg/dl) in ALDH2\*1/2\*1(N=12) and ALDH2\*1/2\*2(N=12) groups after 0.5g/kg alcohol intake

|     | ALDH2*1/2*1(N=12) |             | ALDH2*1/2*2(N=12) |             | Group | Time | Group x Time |
|-----|-------------------|-------------|-------------------|-------------|-------|------|--------------|
|     | 30(min)           | 60(min)     | 30(min)           | 60(min)     |       |      |              |
| BAC | 5.98 ± 0.92       | 4.34 ± 0.62 | 5.27 ± 1.01       | 4.39 ± 0.67 | NS    | <.05 | NS           |

**Table 5.** Comparison of vital signs in ALDH2\*1/2\*1(N=12) and ALDH2\*1/2\*2(N=12) groups an hour after placebo and 0.5g/kg alcohol intake

| Vital signs            | ALDH2*1/2*1(N=12) |                | ALDH2*1/2*2(N=12) |                 | Group | Drug  | Group x Drug |
|------------------------|-------------------|----------------|-------------------|-----------------|-------|-------|--------------|
|                        | Placebo           | Alcohol        | Placebo           | Alcohol         |       |       |              |
| Pulse rate (beats/min) |                   |                |                   |                 |       |       |              |
| Baseline               | 72.80 ± 5.22      | 69.90 ± 6.23   | 68.40 ± 7.37      | 68.30 ± 8.56    |       |       |              |
| Changed value          | - 4.50 ± 9.71     | 2.70 ± 5.36    | - 0.30 ± 3.16     | 25.60 ± 11.19   | <.001 | <.001 | <.001        |
| Blood pressure(mmHg)   |                   |                |                   |                 |       |       |              |
| Systolic               |                   |                |                   |                 |       |       |              |
| Baseline               | 120.80 ± 10.93    | 122.00 ± 11.29 | 119.60 ± 9.75     | 116.10 ± 7.62   |       |       |              |
| Changed value          | - 1.50 ± 8.38     | - 0.20 ± 13.25 | - 2.00 ± 5.72     | 6.30 ± 22.41    | NS    | NS    | NS           |
| Diastolic              |                   |                |                   |                 |       |       |              |
| Baseline               | 73.90 ± 11.12     | 67.20 ± 11.13  | 76.20 ± 6.91      | 70.70 ± 9.01    |       |       |              |
| Changed value          | - 0.40 ± 6.80     | - 1.30 ± 6.53  | - 1.10 ± 3.63     | - 12.00 ± 18.51 | NS    | NS    | NS           |
| Body temperature( )    |                   |                |                   |                 |       |       |              |
| Baseline               | 35.70 ± 0.23      | 35.63 ± 0.50   | 35.58 ± 0.43      | 35.47 ± 0.26    |       |       |              |
| Changed value          | 0.02 ± 0.18       | 0.02 ± 0.50    | 0.11 ± 0.29       | 0.04 ± 0.29     | NS    | NS    | NS           |

Baseline values were measured just before treatment.

Changed values are mean changes from pre-treatment baseline.

CFFT

3) CRT

RRT

(p&lt;.05)

**Table 6.** Comparison of P300 latencies(La ; msec) and amplitudes(Amp ;  $\mu$  V) in ALDH2\*1/2\*1(N=12) and ALDH2\*1/2\*2(N=12) groups 30 minutes after placebo and 0.5g/kg alcohol intake

| P300 ERP Site component | ALDH2*1/2*1(N=12)  |                    | ALDH2*1/2*2(N=12)  |                    | Group | Drug  | Group x Drug |
|-------------------------|--------------------|--------------------|--------------------|--------------------|-------|-------|--------------|
|                         | Placebo            | Alcohol            | Placebo            | Alcohol            |       |       |              |
| Fz P300 Lat             |                    |                    |                    |                    |       |       |              |
| Baseline                | 308.00 $\pm$ 17.87 | 309.50 $\pm$ 17.65 | 310.67 $\pm$ 25.46 | 307.00 $\pm$ 27.69 |       |       |              |
| Changed value           | 0.17 $\pm$ 15.03   | 14.50 $\pm$ 16.03  | -2.50 $\pm$ 16.93  | 49.33 $\pm$ 27.66  | <.05  | <.001 | <.001        |
| P300 Amp                |                    |                    |                    |                    |       |       |              |
| Baseline                | 8.61 $\pm$ 4.19    | 8.12 $\pm$ 4.06    | 10.11 $\pm$ 5.09   | 8.75 $\pm$ 5.32    |       |       |              |
| Changed value           | -1.94 $\pm$ 2.08   | -1.59 $\pm$ 3.46   | -1.39 $\pm$ 2.74   | -3.85 $\pm$ 4.06   | NS    | NS    | NS           |
| Cz P300 Lat             |                    |                    |                    |                    |       |       |              |
| Baseline                | 303.67 $\pm$ 22.35 | 307.33 $\pm$ 22.39 | 308.00 $\pm$ 26.27 | 308.00 $\pm$ 29.11 |       |       |              |
| Changed value           | 3.67 $\pm$ 13.12   | 10.67 $\pm$ 18.49  | 3.33 $\pm$ 12.07   | 43.00 $\pm$ 32.60  | <.05  | <.001 | <.01         |
| P300 Amp                |                    |                    |                    |                    |       |       |              |
| Baseline                | 10.43 $\pm$ 3.95   | 10.99 $\pm$ 4.14   | 11.81 $\pm$ 4.09   | 10.09 $\pm$ 4.53   |       |       |              |
| Changed value           | -2.01 $\pm$ 2.12   | -3.37 $\pm$ 2.45   | -1.58 $\pm$ 2.71   | -4.34 $\pm$ 3.93   | NS    | <.01  | NS           |
| Pz P300 Lat             |                    |                    |                    |                    |       |       |              |
| Baseline                | 305.17 $\pm$ 22.76 | 306.17 $\pm$ 22.23 | 313.17 $\pm$ 27.51 | 309.00 $\pm$ 30.30 |       |       |              |
| Changed value           | 12.33 $\pm$ 11.96  | 23.50 $\pm$ 22.14  | 2.50 $\pm$ 18.45   | 48.83 $\pm$ 32.37  | NS    | <.001 | <.01         |
| P300 Amp                |                    |                    |                    |                    |       |       |              |
| Baseline                | 9.95 $\pm$ 3.71    | 10.23 $\pm$ 3.21   | 11.10 $\pm$ 2.92   | 9.58 $\pm$ 3.56    |       |       |              |
| Changed value           | -1.49 $\pm$ 2.47   | -2.41 $\pm$ 1.71   | -1.42 $\pm$ 2.34   | -3.59 $\pm$ 3.48   | NS    | <.05  | NS           |

Fz indicates mid frontal area : Cz, vertex area : Pz, mid parietal area.

Baseline values were measured just before treatment.

Changed values are mean changes from pre-treatment baseline.

**Table 7.** Comparison of cognitive and psychomotor function in ALDH2\*1/2\*1(N=12) and ALDH2\*1/2\*2(N=12) groups an hour after placebo and 0.5g/kg alcohol intake

| Psychomotor function | ALDH2*1/2*1(N=12)  |                    | ALDH2*1/2*2(N=12)  |                    | Group | Drug | Group x Drug |
|----------------------|--------------------|--------------------|--------------------|--------------------|-------|------|--------------|
|                      | Placebo            | Alcohol            | Placebo            | Alcohol            |       |      |              |
| CFFT(Hz)             |                    |                    |                    |                    |       |      |              |
| Baseline             | 31.24 $\pm$ 2.20   | 31.41 $\pm$ 2.16   | 32.81 $\pm$ 2.39   | 32.66 $\pm$ 2.16   |       |      |              |
| Changed value        | 0.13 $\pm$ 0.81    | 0.72 $\pm$ 0.63    | 0.12 $\pm$ 0.72    | -0.71 $\pm$ 0.92   | <.01  | NS   | <.01         |
| CRT                  |                    |                    |                    |                    |       |      |              |
| RRT(msec)            |                    |                    |                    |                    |       |      |              |
| Baseline             | 351.15 $\pm$ 27.64 | 358.80 $\pm$ 47.03 | 344.10 $\pm$ 10.19 | 361.54 $\pm$ 28.94 |       |      |              |
| Changed value        | 9.24 $\pm$ 21.22   | -3.54 $\pm$ 33.10  | 10.05 $\pm$ 26.68  | 47.30 $\pm$ 29.79  | NS    | <.05 | NS           |
| MRT(msec)            |                    |                    |                    |                    |       |      |              |
| Baseline             | 142.69 $\pm$ 16.20 | 138.15 $\pm$ 27.36 | 142.88 $\pm$ 21.45 | 127.34 $\pm$ 16.00 |       |      |              |
| Changed value        | 8.04 $\pm$ 25.25   | 12.41 $\pm$ 30.54  | 4.39 $\pm$ 23.52   | 30.91 $\pm$ 15.92  | <.05  | NS   | NS           |
| TRT(msec)            |                    |                    |                    |                    |       |      |              |
| Baseline             | 493.88 $\pm$ 28.93 | 497.00 $\pm$ 45.54 | 486.95 $\pm$ 20.21 | 488.87 $\pm$ 33.08 |       |      |              |
| Changed value        | 1.19 $\pm$ 16.54   | -15.97 $\pm$ 36.95 | 5.56 $\pm$ 25.80   | 16.38 $\pm$ 24.28  | <.01  | NS   | <.01         |
| DSST(sore)           |                    |                    |                    |                    |       |      |              |
| Baseline             | 75.83 $\pm$ 7.99   | 81.92 $\pm$ 10.20  | 77.00 $\pm$ 9.38   | 82.75 $\pm$ 11.44  |       |      |              |
| Changed value        | -0.42 $\pm$ 4.14   | 1.33 $\pm$ 3.58    | -1.58 $\pm$ 3.40   | -4.67 $\pm$ 3.85   | <.01  | NS   | <.05         |

CFFT indicates critical flicker fusion threshold : CRT, choice reaction time : RRT, recognition reaction time : MRT, movement reaction time : TRT, total reaction time : DSST, digit symbol substitution test.

Baseline values were measured just before treatment.

Changed values are mean changes from pre-treatment baseline.

**Table 8.** Comparison of subjective response in ALDH2\*1/2\*1 (N=12) and ALDH2\*1/2\*2 (N=12) groups an hour after placebo and 0.5g/kg alcohol intake

| Subjective response <sup>a</sup> | ALDH2*1/2*1 (N=12) |             | ALDH2*1/2*2 (N=12) |             | Group | Drug  | Group x Drug |
|----------------------------------|--------------------|-------------|--------------------|-------------|-------|-------|--------------|
|                                  | Placebo            | Alcohol     | Placebo            | Alcohol     |       |       |              |
| Facial warmness                  | 0.33 ± 0.65        | 0.58 ± 0.79 | 0.25 ± 0.45        | 3.08 ± 1.62 | <.001 | <.001 | <.001        |
| Facial flushing                  | 0.25 ± 0.45        | 0.33 ± 0.65 | 0.08 ± 0.29        | 3.25 ± 1.66 | <.001 | <.001 | <.001        |
| Chest palpitation                | 0.50 ± 0.80        | 0.33 ± 0.65 | 0.33 ± 0.49        | 2.75 ± 1.71 | <.001 | <.001 | <.001        |
| Dizziness                        | 0.33 ± 0.49        | 0.58 ± 0.67 | 0.42 ± 0.79        | 2.08 ± 1.62 | <.01  | <.01  | <.05         |
| Headache                         | 0.58 ± 0.79        | 0.17 ± 0.39 | 0.58 ± 1.00        | 2.00 ± 1.41 | <.01  | NS    | <.01         |
| Nausea/vomiting                  | 0.00 ± 0.00        | 0.08 ± 0.29 | 0.08 ± 0.29        | 1.25 ± 1.29 | <.01  | <.01  | <.05         |
| Sleepiness                       | 1.00 ± 0.43        | 1.17 ± 1.90 | 1.08 ± 0.67        | 3.08 ± 1.73 | <.05  | <.05  | <.05         |
| Gastric discomfort               | 0.33 ± 0.49        | 0.17 ± 0.39 | 0.50 ± 0.80        | 1.42 ± 1.31 | <.01  | NS    | <.05         |
| Dry mouth                        | 0.33 ± 0.49        | 0.17 ± 0.39 | 0.50 ± 0.67        | 2.08 ± 1.88 | <.01  | <.05  | <.05         |
| General weakness                 | 0.17 ± 0.39        | 0.33 ± 0.65 | 0.25 ± 0.45        | 1.83 ± 1.75 | <.01  | <.01  | <.05         |
| Drunk feeling                    | 0.25 ± 0.45        | 0.67 ± 0.65 | 0.08 ± 0.29        | 2.25 ± 1.60 | <.05  | <.001 | <.01         |
| Psychomotor incoordination       | 0.18 ± 0.18        | 0.15 ± 0.13 | 0.08 ± 0.11        | 1.01 ± 1.28 | <.05  | <.05  | <.05         |

a : Each item was rated on a 0 - 6 point scale. 0 denotes 'not at all' and 6 denotes 'extremely severe'. Subjective responses were rated at the end of experiments.

RRT coordination)(p<.05 ; p<.05 ; p<.05)

MRT (p<.05) (headache)(p<.01 ; p<.01), (gastric discomfort)(p<.01 ; p<.05)

MRT

TRT (p<.01)

TRT (p<.01) ( 8).

TRT

고 찰

4) DSST ALDH2

DSST 가 가 가

DSST (p<.01) 가 가

DSST (p<.05) 가 가

6. 주관적 반응 25 2 1/2 0.5g/kg

(facial warmness)(p<.001 ; p<.001 ; p<.001), (Schuckit 1984 ; Teo 1986 ;

(facial flushing)(p<.001 ; p<.001 ; p<.001), (chest palpitation)(p<.001 ; p<.001 ; p<.001), (dizziness) Wall Ehlers 1995)

(p<.01 ; p<.01 ; p<.05), / (nausea/vomiting)(p<.01 ; 가

p<.01 ; p<.05), (sleepiness)(p<.05 ; p<.05 ; p<.05),

(dry mouth)(p<.01 ; p<.05 ; p<.05), (general weakness)(p<.01 ; p<.01 ; p<.05), 가

(drunk feeling) (psychomotor in- BACs

ml/kg 60 P300  
 Cz, Pz 가 Pz 가  
 (Lawrence 1983) . AL -  
 DH2 가  
 ALDH2  
 가 ,  
 가 ( 1991 ; 1996 ;  
 1991) Palva (1979) 0.5g/kg 0.8g/kg  
 가 , Fagan  
 가 (1987) 0.2g/kg, 0.4g/kg 0.8g/kg  
 20 ALDH2  
 가 가 가  
 가 가 ALDH2  
 가 가  
 BACs ( 1985 ; Adachi 1991) (1996) alcohol patch test  
 ALDH2 ALDH2  
 . ALDH acetaldehyde 가 .  
 ALDH acetaldehyde ALDH  
 BACs 가 . 0.75g/kg, 1.0g/kg  
 . BACs acetaldehyde 가 ,  
 ADH ALDH 가 0.5g/kg  
 . 0.5g/kg  
 ALDH2  
 가 ,  
 가 (1996)  
 가 가  
 가 ( 1985 ; 1982 ;  
 1983 ; Regan 1982) AL -  
 DH2 ALDH2  
 ALDH2 (Chao 1995 ; Crabb  
 1989 ; Goedde 1989 ; Higuchi 1991 ; Wall 1992).  
 acetaldehyde 가  
 (Agarwal Goedde 1990 ;  
 ALDH2 Chao 1995 ; Higuchi 1991). BACs  
 가  
 P300 ALDH2  
 가 가 (Romani 1987 ; Roth 1981). acetaldehyde  
 ALDH2 P300  
 가 Fz, Cz, Pz , ALDH2  
 Wall Ehlers(1995) ALDH2 0.75 가 ,

가 가  
가 .  
가 ,  
가  
가

ALDH2 가

가

## 결론

ALDH2

ALDH2\*1/2\*1

ALDH2\*1/2\*2

가

, BACs

30

60

가

, P300

Fz(fr-

ontal), Cz(central), Pz(parietal)

가

. P300

Cz Pz

ALDH2

가

가

중심 단어 : ALDH2 · P300 ·

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