Effect of Water Extracts of Aloe and Some Herbs in Decreasing Blood Ethanol Concentration in Rats. II.

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Oral administration of ethanol to rats at a dose of 3 g/kg decreased alcohol dehydrogenase (ADH) activity and metabolism of lactate to pyruvate in the liver. The effects of water extracts of Aloe and some other herbs on blood ethanol concentration and on ADH activity in liver cytosol were examined. The water extracts of these herbs caused a faster elimination of ethanol from blood of normal rats when administered orally 30 min before oral administration of ethanol. The rapid elimination of ethanol seems to be due to a protection of ADH activity and the supply of nicotinamide dinucleotide, both of which are reduced by high ethanol concentration. The effects of ethanol in decreasing the enzyme activities relating to its own metabolism occur when high concentrations of ethanol pass through the liver, and thus may primarily appear during the absorption of alcohol from the gastrointestinal tract, when portal concentrations of ethanol are very high.

Keywords herb; water extract; blood ethanol concentration; lactate; pyruvate; alcohol dehydrogenase; aldehyde dehydrogenase; *in situ* isolated perfused liver; gluconeogenesis; thiol

Previously, we reported[1] on the effect of water extracts of some herbs such as Alpiniae Katsumadai Semen, Dolichoris Semen and Trapae Fructus in decreasing the blood ethanol concentration in rats after oral administration. In summary, we found that (1) ethanol administration suppressed alcohol dehydrogenase (ADH) activity and aldehyde dehydrogenase (ALDH) activity in liver cytosol; (2) water extracts of some herbs strongly inhibited the effect of ethanol in suppressing the activities of both enzymes when the water extract was administered before the ethanol administration, *i.e.*, they caused a decrease in ethanol concentration in the blood.

In the present study, we continued our investigation on these effects with water extracts of other herbs,[2,3] which are also believed to protect against alcohol toxicity in the liver. Since these herbs are often administered as decoctions, we examined their water extracts. To test for alcohol toxicity prophylaxis, the water extract was administered at 30 min before the administration of ethanol.

Experimental

Materials Herbs examined in the present study were obtained from Tochimoto Tenkaido Co. at the Osaka Market in 1983 and are listed in Table I. They were finely chopped. In terms of extraction, herbs were immersed in deionized water (ten-fold excess by weight) in a round-bottomed flask with a volume of 2 l, for 16 h at a room temperature, and then warmed at 60 °C for 3 h. Each solution was evaporated under reduced pressure at 40 °C to obtain the residue. Extractions were performed with 5 separate samples of each herb, and each extract was tested separately. The yields of the water extracts are listed in Table I. The dose given to rats was determined from the dose recommended for humans, by calculating the dose per kg body weight according to the reported method.[2,3] L-Lactate and pyruvate were obtained Sigma Chemicals Inc. (St Louis, U.S.A.). Other reagents used were of analytical grade.

***In Vivo* Animal Study** Male Wistar rats, weighing 250 to 300 g, were obtained from Shizuoka Laboratory Animal Center (Shizuoka), and were fasted for 24 h prior to experiments, but water was given freely. Rats were anesthetized with urethane (500 mg/kg). Administration of ethanol and water extracts was performed *via* a gastric catheter. The extracts were dissolved in 1.0 ml of distilled water, and the solutions were administered 30 min before the ethanol administration.

After administration of ethanol at a dose of 3.0 g/kg,[4] 0.25 ml of blood was collected from the jugular vein at 1, 2, 3, 4, 5 and 6 h. Two milliliters of 0.33 N hydroperchloric acid was added to 0.25 ml of blood for the assay of ethanol concentration in the supernatant after centrifugation.[5]

TABLE I. Yield[a] and Doses[b] of Water Extracts of Eight Herbs in Rats

Herbs (Origin)	Home	Yield (%)	Dose (mg/kg b.w.)
Aloe (*Aloe ferox* MILLER)	Cape, South Africa	98.9±0.2	237.5± 0.4
Trichosanthis Radix (*Trichosanthes kirilowii* MAXIMOWICZ)	Guangxi, China	37.9±0.5	760.0±10.9
Trichosanthis Semen (*Trichosanthes kirilowii* MAXIMOWICZ)	Guangxi, China	6.8±0.4	202.5±11.1
Ginkgo Semen (*Ginkgo biloba* LINNAEUS)	Ohita, Japan	14.3±0.4	358.3± 9.3
Crataegi Fructus (*Crataegus cuneata* SIEBOLD *et* ZUCCARINI)	Jiangsu, China	11.1±0.3	884.8±27.3
Momordicae Semen (*Momordica cochinsinensis* SPRENGER)	Guangxi, China	5.9±0.4	9.8± 0.6
Smilacis Rhizoma (*Smilax glabra* ROXBURGH)	Guangdong, China	46.7±2.6	778.5±44.1
Myricae Cortex (*Myrica rubra* SIEBOLD *et* ZUCCARINI)	Miyazaki, Japan	13.0±0.8	86.5± 5.5

a) Yield was determined as the average of 5 extractions. *b*) Dose was determined on the basis of the yield of water extract from the herb and the dose of herb used in humans, calculated per kg body weight. Each value represents the mean±S.E. ($n=5$).

In another experiment, 6 ml of blood was collected 1 h after administration of ethanol. Four milliliters of 1 N hydroperchloric acid was added to 4 ml of blood for the assay of lactate and pyruvate levels.[6] Two milliliters of blood was centrifuged at 900 × *g* to obtain serum for the assay of glutamate oxaloacetate transaminase (GOT) and glutamate pyruvate transaminase (GPT) activities.

Just after final collection of blood samples in the above experiments, the entire liver was removed and rinsed gently with 0.25 M sucrose solution at 4 °C. It was sliced, and homogenized with approximately 7 volumes of 0.25 M sucrose solution in a Potter–Elvehjem homogenizer. The homogenate was centrifuged at 600 × *g* for 10 min, followed by further centrifugation of the supernatant at 10000 × *g* for 10 min. The supernatant, obtained by centrifugation at 10000 × *g*, was further centrifuged at

105000 × *g* for 60 min to obtain the cytosolic fraction, which was used for measurement of ADH and ALDH activities.

To further investigate the absorption of ethanol, the *in situ* rat gastric and jejunal loop methods were employed.[7] For this study, the whole stomach and about 10 cm of jejunum were ligated at both ends. Thirty min after administration of ethanol into the loop at a dose of 3 g/kg, the intestinal loop and gastric loop were removed to measure residual ethanol. A test sample of water extract was administered 30 min before the ethanol administration.

***In Situ* Isolated, Perfused Rat Liver Study** Male Wistar rats (90 to 110 g), which had been fasted for 48 h, were anesthetized with sodium pentobarbital (30 mg/kg, i.p.). The isolated, perfused liver was prepared according to Soling *et al.*[8] and perfused with Krebs–Henseleit bicarbonate buffer for 30 min prior to perfusion with 30 ml of the buffer containing glucose precursor and/or ethanol for 30 min. Forty microliters of the perfusate was collected at 5 min intervals for measurement of glucose concentration. Glucose production by gluconeogenesis from L-lactate or pyruvate was calculated from amount of glucose released into the perfusate.[9] The Krebs-Henseleit bicarbonate buffer[10,11] (pH 7.4) contained 1% bovine serum albumin and was saturated with $O_2 : CO_2$ (95 : 5) during the experimental period. The flow rate was 8.0 ml/min. After a 30-min recirculation, the liver was sliced and homogenized as described above. A cytosol fraction was obtained to measure ADH and ALDH activities. Homogenate was also used to measure both nonprotein and protein thiol levels.

Assays Ethanol concentration was determined using an assay kit (F-Kit ethanol®, Boehringer Mannheim Yamanouchi). The limit of detection for ethanol was 2 mM. Serum GOT and GPT were measured by the method of Reitman and Frankel,[12] using an assay kit (S. TA-Testwako®, Wako Pure Chemistry Co., Ltd). Activities of ADH and ALDH were measured by the method of Lebsack *et al.*[13] Assay of pyruvate levels was performed using an assay kit (Pyruvate Test®, Boehringer Mannheim Yamanouchi). Assay of lactate levels was also performed using an assay kit (Lactate Test®, Boehringer Mannheim Yamanouchi), based on the method of Gutmann and Wahlefeld.[14] Assay of nonprotein and protein thiols was performed by the method described by Di Monte *et al.*[15] Assay of protein concentration was performed by the method of Lowry *et al.*[16]

Statistical Analyses Statistical analyses were performed by using Student's *t*-test.

Results and Discussion

Effect on Blood Ethanol Concentrations in Rats after Oral Administration When water extracts were administered orally 30 min before an oral administration of ethanol to rats, significantly lower concentrations of ethanol in blood were observed in comparison to those after an administration of ethanol alone (Fig. 1 and Table II). The elimination of ethanol in rats after oral administration of ethanol alone was slightly slower than that observed in a previous study (k_{el}: $0.129 \pm 0.03\ min^{-1}$, no significant difference in comparison to that in Table II of the present paper). The ethanol concentrations in blood obtained after the administration of ethanol were used to assess the effect of the water extracts.

As shown in Table III, ethanol absorption from gastric loops and jejunal loops in the *in situ* study was rapid, with more than 85% absorption within 30 min. The preadministration of a water extract of each herb did not change the ethanol absorption from either gastric or jejunal loops.

In the previous study using other herbs, we reported only relative differences of blood ethanol concentrations between test animals and controls. In the present study, we discuss the effect of these water extracts in more detail with determination of an apparent elimination rate constant for alcohol, k_{el}. As shown in Fig. 1, elimination of ethanol from rat blood occurred rapidly in test groups, compared to control groups. In this study, comparison parameters were blood ethanol concentration at 1 h, and the apparent elimination constant, k_{el}, calculated from Fig. 1 (Table II). Preadministration of water extracts significantly decreased the blood ethanol concentration 1 h after ethanol administration and increased the k_{el} value; water extracts of Aloe, Trichosanthis Radix and Momordicae Semen were especially effective.

Since absorption of ethanol from the gastrointestinal

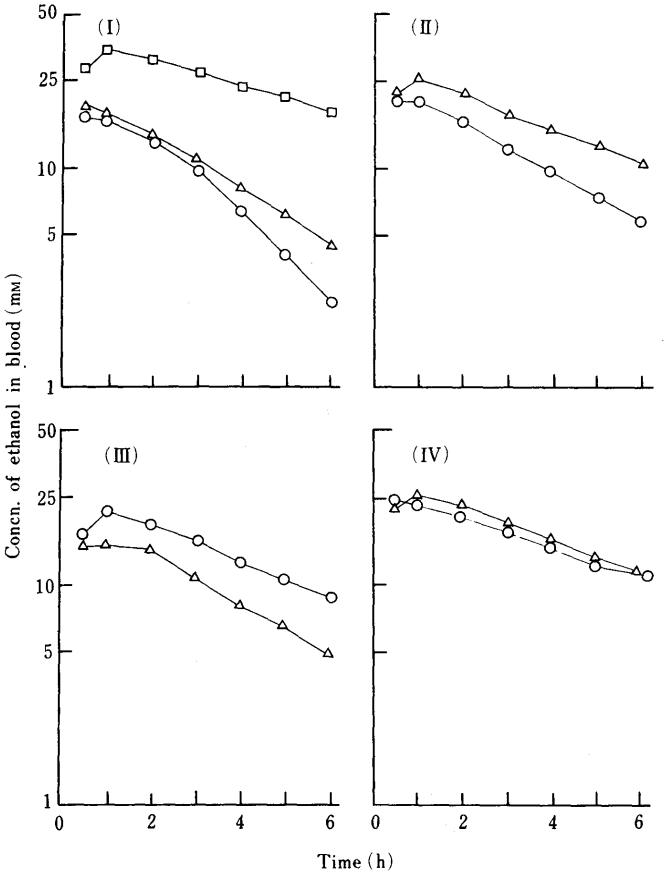

Fig. 1. Effect of Water Extracts of Herbs on Rat Blood Ethanol Concentration after Oral Administration at a Dose of 3 g/kg

Water extract was administered 30 min before ethanol. Open squares (□) represent results after ethanol alone. Water extracts were obtained from the following herbs: A, Aloe; B, Trichosanthis Radix; C, Trichosanthis Semen; D, Ginkgo Semen; E, Crataegi Fructus; F, Momordicae Semen; G, Smilacis Rhizoma; H. Myricae Cortex.
(I) —○—, code-A; —△—, code-B. (II) —○—, code-C; —△—, code-D. (III) —○—, code-E; —△—, code-F. (IV) —○—, code-G; —△—, code-H.
Each value represents the mean ± S.E. ($n = 5$).

TABLE II. Effect of Water Extracts of Herbs[a] on Ethanol Concentration in Rat Blood 1 h after an Oral Administration of Ethanol, and Apparent Elimination Rate Constant, k_{el}, from Rat Blood

Herbs	Ethanol concentration (mM)	k_{el} (min^{-1})
None	33.6 ± 2.0	0.096 ± 0.037
Aloe	16.1 ± 1.9[b]	0.56 ± 0.041[b]
Trichosanthis Radix	17.5 ± 2.0[b]	0.38 ± 0.030[b]
Trichosanthis Semen	19.3 ± 3.4[b]	0.32 ± 0.031[b]
Ginkgo Semen	25.0 ± 1.9[c]	0.18 ± 0.024[c]
Crataegi Fructus	21.9 ± 3.3[c]	0.25 ± 0.027[b]
Momordicae Semen	14.6 ± 1.0[b]	0.35 ± 0.034[b]
Smilacis Rhizoma	25.2 ± 4.2[c]	0.26 ± 0.043[b]
Myricae Cortex	22.8 ± 1.7[c]	0.21 ± 0.011[b]

a) Extract was administered 30 min before the ethanol administration. Each value represents the mean ± S.E. ($n = 5$). *b*) $p < 0.01$ *versus* none. *c*) $p < 0.05$ *versus* none.

TABLE III. Disappearance of Ethanol from Rat Gastric Loop and Jejunal Loop 30 min after Ethanol Administration (3 g/kg) into the Loops, and Effect of Water Extracts of Herbs Administered at 30 min before the Ethanol

Herbs	Percent of ethanol disappeared	
	From gastric loop	From jejunal loop
None (ethanol alone)	94.8±4.6	95.2±4.5
Aloe	92.1±4.3	94.6±2.5
Trichosanthis Radix	89.9±2.2	87.2±3.8
Trichosanthis Semen	90.6±3.5	92.6±3.1
Ginkgo Semen	93.5±1.1	98.0±1.0
Crataegi Fructus	87.9±2.1	87.9±3.1
Momordicae Semen	99.2±0.2	96.1±1.1
Smilacis Rhizoma	87.6±1.1	89.2±0.2
Myricae Cortex	92.3±0.4	93.3±0.1

Each value represents the mean±S.E. ($n=3$).

TABLE IV. Effect of Administration of Water Extracts of Eight Herbs on the Ratio of Lactate to Pyruvate in Blood, and on Serum GOT and GPT Levels in Rats at 1 h after Ethanol Administration (3 g/kg Body Weight)

Herbs	[Lactate]/[pyruvate] ratio	GOT	GPT
		KU	
None	41.9±2.7	101.0± 4.0	20.0±1.1
Ethanol alone	93.3±8.4[a)]	100.4± 4.6	17.2±1.5
Aloe	38.6±8.3	112.5± 8.6	20.1±3.4
Trichosanthis Radix	44.6±4.5	101.1±10.6	21.3±2.8
Trichosanthis Semen	40.3±3.8	110.8± 6.2	17.6±1.6
Ginkgo Semen	32.5±5.9	100.2± 5.9	20.5±2.4
Crataegi Fructus	42.2±8.3	127.6±15.5	18.5±2.7
Momordicae Semen	40.9±6.3	106.7± 4.9	17.1±2.8
Smilacis Rhizoma	47.6±4.5	117.6±11.8	19.2±0.8
Myricae Cortex	51.8±7.2	118.5± 4.5	21.5±1.9

Each value represents the mean±S.E. ($n=5$). *a*) $p<0.001$ *versus* none. KU: Karmen units.

tract was not affected by the preadministration of these water extracts (Table III), low blood ethanol concentration after preadministration of the water extracts must be due to a more rapid elimination of ethanol from blood. It has been reported that more than 90% of the ethanol in blood is metabolized in the liver.[17] Thus, the decrease in ethanol concentration in blood caused by the preadministration of the water extracts may be due to an acceleration of ethanol metabolism in the liver.

It has been reported that nicotinamide adenine dinucleotide (NAD) is required as a coenzyme in ethanol metabolism to acetic acid *via* acetaldehyde in the liver, and that the rate-limiting step is often the oxidation of reduced nicotinamide adenine dinucleotide (NADH),[18] which is produced from NAD by ethanol metabolism. Oxidation of NADH to NAD occurs through metabolism of lactate to pyruvate in the liver.[19] Therefore, it has been widely accepted that determination of the lactate/pyruvate ratio in blood provides a parameter of the NADH/NAD redox state[20]; *i.e.*, a decrease in the ratio indicates that lactate is metabolized to pyruvate along with production of NAD. Thus, in the present study, this ratio in the blood of rats 1 h after ethanol administration was measured to estimate the rate of ethanol metabolism (Table IV).

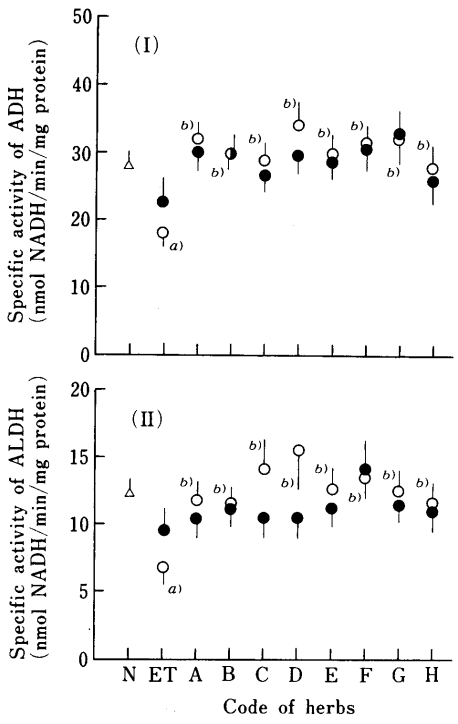

Fig. 2. Effect of Water Extracts of Herbs on ADH Activity (I) and ALDH Activity (II) in Rat Liver Cytosol at 1 h (○) and 6 h (●) after Oral Ethanol Administration

An extract was administered orally at 30 min before ethanol administration. The values indicated by N and the symbol△ represent the results obtained from rats without any administration. The values indicated by ET represent the results after administration of ethanol alone. Water extracts were obtained from the herbs indicated by the same letters as used in Fig. 1.

Each value represents the mean±S.E. ($n=5$). *a*) $p<0.05$ *versus* the value without ethanol; *b*) $p<0.01$; *c*) $p<0.001$.

The administration of ethanol alone increased the lactate/pyruvate ratio significantly (Table IV). However, the preadministration of the water extract inhibited the increase in the lactate/pyruvate ratio after ethanol administration. These findings indicate that the administration of ethanol alone probably decreases the supply of NAD needed for ethanol metabolism in the liver, by inhibiting the metabolism of lactate to pyruvate. The preadministration of the water extracts inhibited this effect of ethanol. Thus, it is considered that ethanol inhibits its own metabolism by decreasing the NAD supply, and preadministration of the water extract seems to normalize the supply of NAD necessary for ethanol metabolism.

To examine the effect of ethanol at a dose of 3 g/kg on liver function, serum GOT and GPT were measured 1 h after ethanol administration. As shown in Table IV, administration of ethanol and/or the water extract did not change the levels of serum GOT and GPT. Thus, it is considered that serious disorder of liver function was not caused by a single administration of ethanol even at a high dose of 3 g/kg.

We concluded that ethanol administration to rats at a dose of 3 g/kg inhibits liver metabolism of lactate to pyruvate, which in turn may be related to a diminished supply of NAD, a coenzyme of ethanol metabolism. The preadministration of a water extract of these herbs inhibits such metabolic interference from ethanol, and tends to normalize the NAD supply necessary for ethanol metabolism.

Effect on Activities of ADH and ALDH in Rat Liver after Oral Administration of Ethanol An oral administration of ethanol alone (control) caused a decrease in ADH activity in rat liver cytosol at 1 h, compared to values before ethanol administration (Fig. 2I). This activity was restored at 6 h (Fig. 2I). The decrease in ADH activity observed in this study is not due to a reduced supply of NAD, because sufficient NAD was supplied exogenously in the cytosolic fluid obtained. This finding indicates that an administration of ethanol at a high dose of 3 g/kg, directly causes a reduction in the cytosolic ADH activity.

It has been reported[17] that more than 90% of the ethanol in blood is metabolized in the liver, and that the first step of ethanol metabolism is conversion to acetaldehyde by ADH. Since it is considered that the rate of ethanol metabolism to acetaldehyde is inversely proportional to blood ethanol concentration, the effect of an oral administration of the water extracts of eight herbs listed in Table I on ADH activity in liver cytosol was investigated at 1 h and 6 h after the ethanol administration (Fig. 2).

When the water extracts of herbs in Table I were administered 30 min before an ethanol administration, these water extracts inhibited the decrease in ADH activity in the cytosol 1 h after ethanol administration (Fig. 2).

Acetaldehyde produced from ethanol by ADH is metabolized to acetic acid by ALDH in the liver, and is also a cytotoxic metabolite. Thus, it is important to measure the activity of ALDH in liver cytosol to estimate the rate of conversion of acetaldehyde to acetic acid, because ALDH is found in the cytosol as well as in the mitochondria of liver.[21] The administration of ethanol alone decreased the activity of ALDH in the cytosol at 1 h, but recovery of ALDH activity was observed at 6 h (Fig. 2II), as observed with the ADH activity (Fig. 2II).

Water extracts, when they were administered 30 min before ethanol, inhibited the decrease in ALDH activity (Fig. 2II).

In conclusion, the blood ethanol concentration after an oral administration seems to be inversely dependent on the activity of ADH in liver cytosol; *i.e.*, water extracts of these eight herbs seem to induce a rapid decrease in blood ethanol concentration through two dominant effects: (1) maintenance of a sufficient supply of NAD as a coenzyme of ethanol metabolism in liver, and (2) inhibition of the ethanol-induced decrease in ADH activity in liver cytosol. Thus, the protective effect of these herbs against alcohol toxicity may be due to a protection of normal metabolic mechanisms occurring in the liver.

Effect of Ethanol at Various Concentration on *in Situ* Isolated, Perfused Rat Liver The above observations indicate that the water extracts of herbs in Table I prevent the effect of ethanol in inhibiting its own metabolism in liver. In further experiments using an isolated, perfused rat liver method, we investigated the effect of ethanol on gluconeogenesis from L-lactate or pyruvate, in order to clarify the effect of ethanol on the metabolism of lactate to pyruvate. That is because L-lactate is a major glucose precursor, and it is metabolized to glucose after formation of triose phosphate *via* pyruvate.[22]

When the rat liver was recirculated with the buffer in the presence of 10 mM L-lactate or 10 mM pyruvate, a greater rate of glucose production was observed than in the absence of substrate.[9]

Rates of glucose production during the recirculation in the absence (GR_{ab}) or in the presence (GR_{sub}) of substrate were calculated by means of Eq. 1, as described previously.[9]

$$GR_{ab} \text{ or } GR_{sub} = [G_{t+5} - G_t] \text{ (volume of the medium)} / [(t+5) - t] \text{ (wet weight of whole liver)} \quad (1)$$

where G_{t+5} and G_t represent the concentrations of glucose in the medium at $(t+5)$ min and t min after starting the recirculation, respectively. The rate of glucose production from substrate by gluconeogenesis (GR) was calculated by using Eq. 2.

$$GR = GR_{sub} - GR_{ab} \quad (2)$$

As shown in Table V, the high concentrations of ethanol, 100 and 500 mM, increased the value of GR_{ab} slightly. This slight increase in GR_{ab} by the presence of the ethanol is due to an increase in glycogenolysis, as reported previously.[22]

When L-lactate was used as a glucose precursor, the presence of ethanol in the medium at 10 mM or at 25 mM did not change the GR value, but ethanol at 100 mM or at 500 mM caused a significant decrease in GR value (Table V). When pyruvate was the precursor, ethanol did not cause a significant change in GR value (Table V). These observations indicate that ethanol at a high concentration inhibits the metabolism of lactate to pyruvate. This result supports the view that ethanol inhibited NAD production by inhibition of the metabolism of lactate to pyruvate in the *in vivo* study. It should be noted that the concentration of ethanol required to inhibit gluconeogenesis is high, at more than 100 mM.

To investigate the concentration dependency of the

TABLE V. Rate of Glucose Production[a] (GR_{ab} and GR) in the Isolated Perfused Liver of Rats

Ethanol (mM)	GR_{ab}	GR (nmol/min/g-liver) in the presence of	
		10 mM L-lactate	10 mM pyruvate
0	12.6±0.4	81.2±5.6	109.7±14.6
10	13.1±0.6	90.2±4.6	112.6± 6.2
25	13.9±1.3	92.2±6.9	104.6± 5.2
100	16.7±1.4[b]	42.6±7.1[c]	98.1± 7.9
500	16.9±1.2[b]	34.1±5.6[c]	91.7± 8.6

a) GR was determined as the average rate of glucose production for 30 min. Each value represents the mean±S.E. ($n=4$ to 6). *b*) $p<0.05$ *versus* 0 mM ethanol. *c*) $p<0.001$ *versus* 0 mM ethanol.

TABLE VI. The Effect of Ethanol on Isolated, Perfused Rat Liver

Concn. of ethanol (mM)	n	Thiols (nmol/mg-protein)		ADH (nmol/min/mg-protein)	ALDH (nmol/min/mg-protein)
		Nonprotein	Protein		
None	5	31.9±0.8	100.1±11.6	31.2±1.1	13.9±1.7
10	4	30.4±1.9	99.2± 9.7	33.7±2.1	12.9±2.1
25	5	28.6±2.6	97.5± 7.2	42.8±3.9	14.6±2.7
100	6	25.1±0.9[a]	97.6± 6.2	19.2±3.1[b]	12.0±1.7
500	5	22.1±1.4[a]	98.9± 3.8	17.2±1.4[b]	9.1±0.7

Each value represents the mean±S.E. *a*) $p<0.05$ *versus* none. *b*) $p<0.01$ *versus* none.

ethanol effect on the activities of ADH and ALDH in rat liver, the isolated perfused liver was homogenized and centrifuged to obtain the cytosol fraction, after a 30-min recirculation. The blood alcohol concentration obtained from peripheral blood was lower than that passing through the liver at least for earlier sample time, because ethanol concentration in the portal vein after intestinal absorption is expected to be quite high. We have recently reported[23] a good correlation between chemically induced liver injury and nonprotein or protein thiol loss in liver tissue. Thus, in the present study, we measured nonprotein thiol, protein thiol, ADH activity and ALDH activity after perfusion with various concentrations of ethanol for 30 min.

As shown in Table VI, ethanol at concentrations less than 100 mM in the perfusate did not cause a change in either nonprotein or protein thiol levels. At a concentration of 100 mM, ethanol caused a significant decrease in ADH activity. When 500 mM ethanol was perfused, a significant decrease in ADH and ALDH activities was observed, and nonprotein thiol loss was also observed. These results indicate that ethanol at a high concentration caused a decrease in the activities of ADH and ALDH. The decrease in ADH activity may be in some way related to nonprotein thiol homeostasis in the liver.

As mentioned earlier, blood ethanol concentrations obtained in this study were from the peripheral blood circulation. However, it is assumed that significantly higher ethanol concentrations pass through the liver just after absorption from the gastrointestinal tract, because ethanol absorption occurs very rapidly. Thus, the decrease in ADH activity in the liver 1 h after administration of ethanol at 3 g/kg may be due to the initially high ethanol concentrations encountered in portal blood.

In the future, we plan to use the isolated, perfused rat liver method to investigate the effect of these water extracts on ethanol metabolism.

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