

## Effects of *Panax ginseng* on Alcohol Detoxification

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### Abstract

To assess the effect of *Panax ginseng* on the detoxification of ethanol, we examined its effect on blood ethanol clearance in both man and experimental animals and on the rate of ethanol oxidation to carbon dioxide in experimental animals. Fourteen healthy male volunteers were subject to studies. The blood alcohol level in the test group receiving ginseng extract (3g/kg b.w.) along with alcohol (70g/65kg b.w.) was about 35% lower than their control levels at 40 min after ethanol intake. When the blood alcohol level was compared on individual bases, blood alcohol concentrations in 10 subjects ranged from 32 to 51% lower than their control values. The remaining 4 subjects appeared to have a high tolerance level.

In experimental animals, the blood alcohol clearance was also much faster in test animals receiving ginseng along with ethanol. The rate of ethanol elimination was determined by the amount of  $^{14}\text{CO}_2$  in exhaled air following the administration of [ $^{14}\text{C}$ ] ethanol. During the first 7 1/4 hr (Phase I) after the ethanol administration, the  $\text{CO}_2$  output was greater in test animals receiving ginseng along with ethanol, whereas from beyond 7 1/4 hr to the near end (Phase II), the  $\text{CO}_2$  output in control animals was over twice that in test animals. The present studies clearly demonstrate that ginseng promotes the overall metabolism of ethanol, resulting in an enhanced blood alcohol clearance and alcohol elimination.

### Introduction

Ethanol is a mood-altering drug. Yet, drinking is socially accepted. Many people occasionally overdrink and face serious consequences along with hangovers. Over-consumption distorts liver functions and causes numerous disorders as well as pathologic? damage to liver tissue (1). Thus, the acceleration of the elimination of ethanol from the system should help to alleviate many detrimental effects caused by ethanol. It has been reported that ginseng increases alcohol dehydrogenase (ADH) and aldehyde dehydrogenase (ALDH) activity in mice (2,3). We studied the effects of ginseng on blood alcohol clearance both in man and in experimental animals and also examined its effect on overall alcohol elimination in experimental animals as determined by the amount of  $^{14}\text{CO}_2$  exhaled following the administration of [ $^{14}\text{C}$ ] ethanol. The present experimental data clearly indicate that ginseng promotes ethanol oxidation and there by enhances blood alcohol clearance and alcohol elimination.

### Materials and methods

**Experimental design for clinical experiments:** The subjects were male volunteers between the ages of 25 and 35, weighing 55 to 75 kg, and having similar drinking habits. In addition they had not taken ginseng in any form for at least one month prior to the experiment. Each individual served as his own control, and the time lapse between experiments was 1 week. The control group received 70g of alcohol/65kg b.w. (25% in alcohol content). The test group received alcohol plus 3g of ginseng extract/65kg b.w. To simulate the usual drinking pattern, the alcohol was divided into 7 portions: the first 4 portions were taken at 5-minute intervals and the last 3 portions at 10-minute intervals. Horsd'ouvres such as vegetables and raw fish fillets were provided in proportion to the weight of each individual and consumed evenly throughout the entire experimental period. Forty minutes after the last drink, blood samples were taken from forearm veins.

**Preparation of Ginseng Extract:** Dried ginseng root was extracted 3 times in 10 vol. (w/v) of water at about 100°C for 8hr. The extracts were combined, centrifuged at 10,000 x g for 30 min, and lyophilized. The overall yield was about 50% for the dry weight of the root.

**Blood Alcohol Clearance in Experimental Animals:** Male Sprague-Dawely rats (200g body weight) were used. A total of 3.6 g ethanol (30%)/kg b.w. was administered (p.o) in 3 portions at 5 min intervals. Blood samples were taken by heart puncture.

**Collection of  $^{14}\text{CO}_2$ :** A total of 3.6 g [ $^{14}\text{C}$ ] ethanol (30%)/kg b.w. was administered (p.o) in 3 portions at 5 min intervals. The specific activity of [ $^{14}\text{C}$ ] ethanol was 48  $\mu\text{Ci}/\text{mole}$ . For each experiment, 3 rats (male Sprague Dawely rats, 200g body weight) were used. The apparatus used for the collection of exhaled  $^{14}\text{CO}_2$  consisted of a restraining cage which was connected to silica gel tube and two collection bottles each containing 40 ml of  $\text{CO}_2$  trapping reagent (50% ethanolamine in methanol). Incoming air which was dried over silica gel and freed of atmospheric  $\text{CO}_2$  with soda lime, was drawn through the restraining cage at a flow rate of 0.5 l/min. The radioactivity in the trapping solution was determined in Bray's scintillant by scintillation spectrometry.

**Determination of Blood Alcohol Concentration:** Blood alcohol concentration was quantified by the method of Buchler and Redetzki (4).

### Results and Discussion

To assess the effects of ginseng on blood alcohol clearance in man, 14 healthy volunteers were subject to the studies(5).

As shown in Fig. 1, 40 min after the ingestion of an acute dose of alcohol (70g of ethanol/ 65kg body weight), the blood alcohol level of the control group was 0.18%, while that of the test group receiving 3 g of ginseng extract per 65kg body weight along with alcohol was 0.11%, only 65% of the control value. When the blood alcohol levels were compared on individual bases (Fig. 2), 10 out of 14 test subjects had significantly lower blood

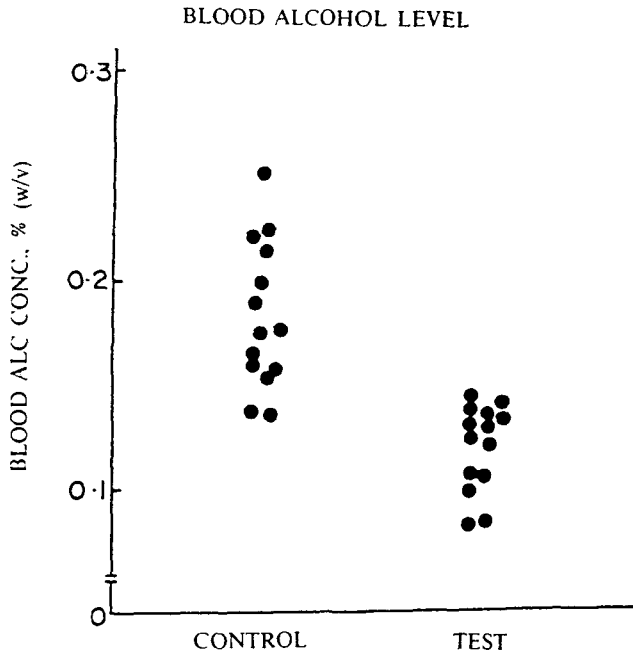


Fig. 1. Control: Alc. 1.077 g/kg B.W. (taken in a period of 45 min.)  
 Test: Alc. 1.077 g/kg B.W.+Ginseng 46 mg/kg B.W.  
 \* Each individual was his own control

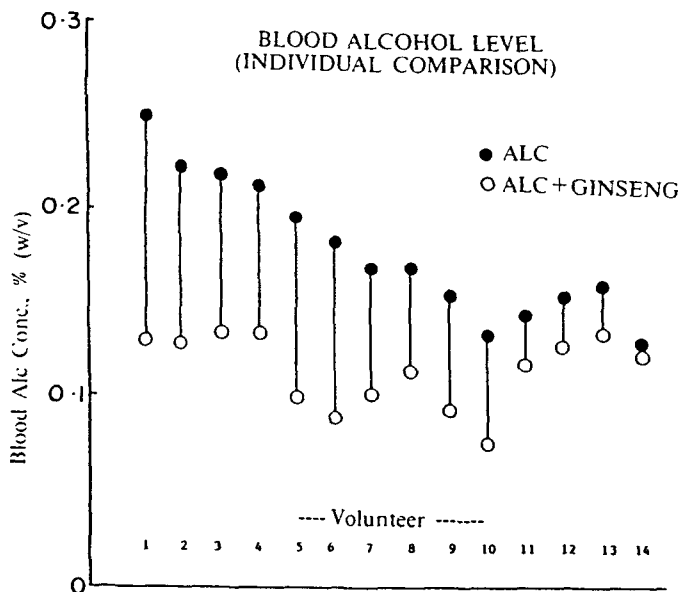


Fig. 2. Control: Alc. 1.077 g/kg B.W. (taken in a period of 45 min.)  
 Test: Alc. 1.077 g/kg B.W.+Ginseng 46 mg/kg B.W.  
 \*Each individual was his own control.

alcohol levels, ranging from 32 to 51% of their corresponding control levels. The remaining 4 subjects did not respond to ginseng as much, they appear to have a high alcohol tolerance. When compared to the rest of the individuals, their control blood alcohol levels were quite low and even the test levels were not too high despite their low response to ginseng. Effects of ginseng are pronounced when the control blood alcohol levels are high.

In the animal experiments, the effects of ginseng on blood alcohol clearance was also clearly demonstrated. At 40 min after the administration of ethanol 3.6g/kg b.w., the blood ethanol concentration in control animals reached its maximum, over 0.2% and decreased in a linear manner up to 120 min. Only a slight further decline was observed in the next 60 min. In test animals receiving ginseng extract 250 mg/kg b. w. along with alcohol, the effect of ginseng was quite pronounced. Even at 40 min, the blood alcohol level was significantly lower than the controls registering about 65% of the control value. Furthermore, it declined in a linear manner up to 180 min.

Consequently, at 60 min after the alcohol administration, the blood alcohol level in test animals was 0.13% and to reach the same level it took about 45 min longer for the controls. The effect of ginseng was even more pronounced at 180 min: the blood alcohol levels of test animals was much lower, less than half the concentration of the control animals.

From these data it is clear that ginseng promotes blood alcohol clearance in both man and experimental animals. Thus to examine the effects of ginseng on the overall metabolism of ethanol, we compared the rate of the production of CO<sub>2</sub> which is final oxidation product of ethanol: the CO<sub>2</sub> curve was divided into two phases, Phase I and Phase II. At 7 1/4 hr after the alcohol administration the two curves intercept dividing Phase I from Phase II. Phase II is the period which we would traditionally define as the "hangover period," approximately 7-8 hr after alcohol intake. There was a significant difference in the CO<sub>2</sub> production pattern between the control and test animals receiving ginseng extract 250 mg/kg b. w. along with alcohol. In Phase I, from 0 to 7 1/4 hr after the administration of alcohol, the CO<sub>2</sub> production in test animals was over 85% of the total CO<sub>2</sub> output, while that in control animals was less than 70%. Consequently, in Phase II, from beyond 7 1/4 hr to the near end, the amount of CO<sub>2</sub> exhaled was much greater in control animals, over twice that in test animals.

These results indicate that in control animals a significant portion of alcohol breakdown was still taking place even 7 1/4 hr after the alcohol administration, whereas in test animals, much of the alcohol elimination was completed before the hangover period. This seems to explain why one does not experience a hangover when alcohol was ingested with ginseng.

In conclusion, all of these experimental results clearly demonstrate that ginseng promotes the overall metabolism of ethanol and thereby enhances blood alcohol clearance and alcohol elimination. As to the mode of action of ginseng on alcohol clearance, it appears that ginseng increases alcohol oxidizing enzyme activity and thereby promotes at least in part the oxidation of ethanol to aldehyde, followed by further oxidation to acetate. However, during acute ethanol intoxication, the microsomal ethanol oxidizing system (MEOS) appears to operate for the oxidation of ethanol (6,7), and a possible role of ginseng on the MEOS should be taken into consideration (8). Finally, it will be of great interest to study the effect ginseng on the economy of the cofactor NAD which is linked to ethanol oxidation (9-11). At high ethanol concentrations, the availability of the cofactor NAD could be a rate-limiting factor rather than the oxidizing enzyme ADH itself.

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## 인삼의 알콜해독 효과

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건강한 성인남자 14명을 대상으로 하여 혈중 알콜해독에 미치는 인삼의 효과 관찰 실험을 실시하였다. 술과 인삼을 동시에 마시는 시험군과 술만 마시는 대조군을 설정하여, 술을 마신후 40분이 경과하였을 때 혈중알콜농도를 측정하였다. 술 (70g/65kg 체중)과 동시에 인삼 (3g/65kg체중)을 먹었을 때의 혈중알콜농도 (0.11%)는 대조군의 혈중알콜농도 (0.18%)의 약 65%이었고, 또 혈중알콜농도를 각 개인별로 비교해보면 실험대상자 14명중 인삼과 술을 동시에 마셨을때의 혈중 알콜농도가 술만 마셨을 때의 혈중 알콜농도의 68%-49%에 불과한 사람이 10명이나 되었다. 인삼의 알콜 배출속도에 미치는 영향을 관찰하기 위한 방사능이 표시된 알콜을 실험동물에 투여한 후 알콜의 대사물질인  $^{14}\text{CO}_2$ 가 호흡을 통하여 배출되는 양을 측정비교 하였다. 알콜 투여후 2-7시간 사이의  $^{14}\text{CO}_2$  배출속도는 알콜의 대사 및 배출속도를 증가시켜 알콜해독을 촉진한다는 것을 설명해주고 있다.