

Changes in Systemic Blood Pressure and Serum Xanthine Oxidase Activity Induced by The Stimulation of Alcohol Metabolism by Fructose in Man

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ABSTRACT

The stimulation of ethanol oxidation and hence, its clearance from bloodstream by the administration of fructose significantly ($P < 0.05$) increased both systemic blood pressure and serum xanthine oxidase activity when compared with the basal (0 hour) value, 15 hours after ingestion. The use of fructose to fasten the removal of alcohol from blood may be highly associated with the risk of hypertension (high blood pressure) elicited by the increased activity of serum xanthine oxidase. Further investigations and the role of dietary supplements and interventions are required to enhance the understanding of the metabolic effects of fructose in stimulating alcohol elimination from the body.

Key words: Ethanol, Xanthine oxidase, Blood pressure, Fructose

INTRODUCTION

In addition to the oxidation of blood ethanol to acetaldehyde (ethanol + NAD^+ acetaldehyde + $\text{NADH} + \text{H}^+$) by the cytosolic alcohol dehydrogenase, ADH, and then, to acetate (acetaldehyde + NAD^+ acetate + $\text{NADH} + \text{H}^+$) by the low K_m mitochondrial acetaldehyde dehydrogenase, ALDH, the activities of these enzymes also produce excess NADH in the liver (Peters and Preedy, 1998). The generation of high amounts of NADH seems to influence a number of metabolic disorders associated with chronic alcohol consumption. Some of these disorders include increased reactive oxygen species (ROS) reactivities (Bailey, *et al.*, 1999), oxidation of endothelial nitric oxide, NO (Bailey and Cunningham, 1998), known to stimulate xanthine oxidase activity (Houston, *et al.*, 1998).

Fructose has been reported to increase the rate of blood alcohol elimination (Onyesom and Anosike, 2004) by accepting reducing equivalents from NADH to generate NAD^+ for enhanced alcohol

oxidation (Berman, *et al.*, 2003). Therefore, fructose may be able to ameliorate the associated metabolism disturbances and reverse the effects of alcohol in the body.

In this study, the changes in serum xanthine oxidase activity and blood pressure measures induced by fructose enhanced elimination of alcohol from blood stream were assessed in order to ascertain the theoretical tendency of fructose to reduce or prevent alcohol metabolic disorders.

MATERIAL AND METHODS

Subjects

Twenty-two consenting male individuals in apparent good health, between the ages of 27-34 years and weighing between 56-63 kg were enlisted for the study.

The volunteers were tested at two different times separated by 14 days. On the first occasion, they were given a single dose of 0.70g (190 proof

USP) ethanol/kg body weight after diluting to 20% with orange juice. On the second occasion, 0.5g fructose/kg body weight was orally administered after about 18-23 min of ingesting the same single dose of ethanol.

Blood pressure measurement

Before blood sample collection, blood pressure measurements were taken after about 10-12 min of rest in a well seated position as earlier described (Onyesom, 2002) using the full automated digital arm blood pressure monitor (SE-7000: Seinex Electronics, Ltd., UK).

Blood sample collection: At different specified post administration time intervals (0, 90 and 720 min), fasting intravenous whole blood samples were collected into sterile plain tubes, centrifuged at 1200 X g for 5 min at room temperature (27-31°C). The supernatant (serum) was decanted into bijoux bottle and analyzed fresh within the hour of collection.

Determination of serum xanthine oxidase activity

Serum xanthine oxidase activity was

assayed by the decoloration of methylene blue (Eissenthal and Danson, 1992) using spectrophotometer.

Statistics

Analysis of variance (ANOVA) was used to compare mean values and $P < 0.05$ was considered significant (Winer, *et al.*, 1991).

RESULTS

The results obtained are shown on Table 1. Table 1 has the records of the mean values obtained for the changes in serum xanthine oxidase activity and blood pressure measures induced by ethanol alone and ethanol + fructose in man.

Fifteen hours (15h) after the consumption of ethanol alone or ethanol + fructose, serum xanthine oxidase activity and systemic blood pressure significantly increased ($P < 0.05$) when compared with the basal (0 hr) value (Table 1). Changes induced by ethanol + fructose were higher when compared with levels induced by ethanol.

Table 1: Changes in serum xanthine oxidase activity and blood pressure induced by ethanol and ethanol + fructose in man

Administrations Post administration time (h)	Ethanol alone (0.7g/kg)			Ethanol + fructose (0.7g+0.5g/kg)		
	0	1.5	15	0	1.5	15
Xanthine oxidase activity ($\mu\text{kat/L}$)	5.02 \pm 1.83	5.11 \pm 1.91	5.43 \pm 1.84*	5.06 \pm 1.72	5.13 \pm 1.56	5.64 \pm 1.92*
Systolic blood pressure (mmHg)	105 \pm 16	113 \pm 12	138 \pm 15*	108 \pm 10	116 \pm 13	138 \pm 12*
Diastolic blood pressure (mmHg)	67 \pm 7	69 \pm 9	74 \pm 11	65 \pm 9	68 \pm 16	76 \pm 9*

Values are expressed as Mean \pm SD for n=22 subjects.

* $P < 0.05$ compare with the 0hr value.

DISCUSSION

Fructose administration has been observed to stimulate the oxidation of blood alcohol and consequently reduces intoxication time (Onyesom, 2002). However, present study suggests that such stimulation caused increased xanthine oxidase activity associated with high blood pressure.

The metabolism of ethanol increases electron flow through the respiratory chain, and this generates reactive oxygen species, (Bailey, *et al.*, 1999) known to produce which stimulates xanthine oxidase activity via suffhydryl oxidation of xanthine dehydrogenase (Houston, *et al.*, 1998).

The stimulation of xanthine oxidase activity results in an increase of juxtaglomerular rennin and decreases nitric oxide, NO (a potent regulator of vasoreactivity) availability (Koppenol, 1998) by repressing macula densa neuronal NO synthase activity (Mazzaili, *et al.*, 2001)

Xanthine oxidase has been implicated as a key oxidative enzyme in the pathogenesis of oxidant – induced microvascular changes and hypertension (Terada and Willingham, 1991). The administration of fructose to hasten the oxidation of blood alcohol and hence its clearance, may confer high risk of cardiovascular dysfunction and damage, evidence (Table I) suggests.

The inhibition of xanthine oxidase activity by sodium tungstate enriched diet has been observed to lower microvascular tone and systemic blood pressure (Terada and Willingham, 1991). The administration of fructose to hasten the oxidation of blood alcohol and hence its clearance, may confer high risk of cardiovascular dysfunction and damage. However, the role of sodium tungstate supplemented diet on the associated risk should be verified.

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