EFFECTS OF THE AD LIBITUM CONSUMPTION OF ETHANOL ON THE SERUM LIPIDS METABOLITES AND ON SOME SERUM BIOMETALS STUDIED ON AN ANIMAL MODEL

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ABSTRACT

Ethanol consumption influences the lipid, electrolyte, carbohydrate as well as the protein metabolisms in humans. Experimental studies with ethanol administration in laboratory animals revealed metabolic changes similar to those in humans. This experimental study was performed on Wistar strain rats divided in three groups: one control C and two experimental ones, i.e. E_1 - with occasional alcohol consumption and E_2 – with chronic consumption. At the end of the experiment (30 days) the animals were killed and blood samples were collected for biochemical determinations. Serum lipid mtabolites (HDL-cholesterol, LDL-cholesterol, triglycerides) and the concentration of some serum metals (Na, K, Ca, Mg, Fe) were determined. The obtained results showed homeostatic changes with physiological and physiopathological implications. One can conclude that chronic ethanol consumption affects more significantly the serum lipids and metals homeostasis than the occasional one.
Key words : occasionally and chronic ethanol consumption – effects in Wistar rats

INTRODUCTION

Ethanol is rich in calories, poor in nutrients and reduces the absorption of other foodstuff from intestine. Also, ethanol might induce changes the biochemical homeostasis in animals and humans, inducing dyslipidemia and disorders in metals homeostasis.

Alcohol consumption, both acute and chronic, has major effects on the absorption, elimination, and serum concentrations of many physiologically important electrolytes and minerals, including sodium, potassium, phosphorus, calcium, magnesium, iron, zinc, and selenium (Friedman etal., 1988; Marsano, 1989; Garban, 1993). Electrolyte disturbances may lead to severe and even life-threatening metabolic abnormalities.

The purpose of this investigation was to underline the ethanol effect on the homeostatic status of the lipid metabolism, such as triglycerides and cholesterol fractions (HDL and LDL) and the homeostasis of some serum metals.

MATERIALS AND METHODS

Experimental animal model : Wistar strain rats (males and females) with an average body weight (b.w.) of 150 ± 10 g were divided in three groups: one control (C) and two experimental (E_1 and E_2). Each group comprised 8 animals (4 males and 4 females). Rats of group C consumed tap water. To animals of experimental groups ethanol of 20% concentration (v/v) in the water was administered orally, ad libitum. In animals of group E_1 ethanol was administered occasionally, once at four days, during 24 hours. In experimental

group E_2, ethanol was administered permanently in drinking water. On the 30th day of the experiment, after 16 hours of fasting, after Ketanest anesthesia, the animals were killed. Blood samples were taken for analyses after laparotomy and puncture of vena cava caudalis.

Analytical determinations : The triglycerides and cholesterol fractions: HDL and LDL were assayed through enzymatic methods, using a Hospitex – Screen Master Plus analyzer. By flamphotometry the concentration of the Na and K and by atomic absorption spectrometry the concentration of Ca, Mg and Fe were determined.

Statistical analysis : The obtained data were statistically proceeded, mean value (X), standard deviation (SD) and the statistical significance as the student's *t* test were used.

RESULTS AND DISCUSSIONS

Literature data showes that ethanol causes a significant change in the metabolism of lipids and lipoproteins (Feinman and Lieber, 1999; Daher et al., 2003). Chronic ethanol intake (i.e. several weeks or months in experimental animals) enhances the damaging consequences of these events through a variety of mechanisms. Ethanol promotes oxidative stress, by depletion of oxidative defenses in the cell (Smith, 1991; Lieber, 1999; Hoek and Pastorino, 2002).

In clinical chemistry HDL-cholesterol is considered to be a beneficial lipoprotein, its large particles can remove cholesterol from atheroma and has a negative effect on the development of fatty liver (Kono et al., 2001), According to Hannuksela (2004) an increased concentration of HDL-cholesterolemia correlates with lower rates of atheroma progressions and even regression. In pathobiochemisstry elevated concentration of LDL-cholesterolemia promotes atheroma formation on the walls of arteries, a condition known as atherosclerosis, which is the principal cause of coronary heart disease and other forms of cardiovascular disease.

Cholesterol plays a central role in many processes, but is best known for the association of cardiovascular disease with various lipoprotein cholesterol transport patterns and high levels of cholesterol in the blood (Stewart at al., 2001).

Our results concerning the concentration of lipid metabolites (mg/dL) in serum of Wistar rats are presented in Table 1.

Table 1. Concentration of triglycerides, HDL-cholesterol and LDL-cholesterol in blood serum after ethanol administration

Animal groups	n	UM	Triglycerides mg/dL	HDL-cholesterol (mg/dL)	LDL-cholesterol (mg/dL)
			$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$
Group C	8	mg/dL	71.08 ± 10.31	35.13 ± 5.33	22.11±3.59
Group E_1	8	mg/dL	77.50 ± 8.19	50.11 ± 7.12	24.70 ± 4.33
ΔX_1			+ 6.42	+ 14.98	+ 2.59
Grup E_2	8	mg/dL	92.83 ± 10.44	53.42± 8.57	34.36 ±8.32
ΔX_2			+ 21.75	+ 18.29*	+ 12.25*

n – number of animals * $P < 0.01$

From the obtained data, one can observe that trygliceridemia, HDL-cholesterolemia and LDL-cholesterolemia are higher in experimental groups as compared to control and the increase is higher in case of chronic administration - E_1 compared to occasionally consumption – E_2.

Alcohol has been shown to reduce serum calcium concentrations in several animal studies. The effect of alcohol consumption on serum magnesium concentrations is controversial (Matti Välimäki et al. 1983); some studies revealed an increase and other decrease.
In table 2 there are presented the results obtained during this study on the experimental animals.

Table 2. Concentration of the investigated metals in the blood serum after ethanol administration

Animal groups	n	Concentration of biometals				
		Na (mEq / L)	K (mEq / L)	Ca (mg %)	Mg (mg %)	Fe (μg %)
		$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$	$\bar{X} \pm SD$
C	8	140.72±6.95	4.23±0.41	9.23±0.72	1.85±0.32	94.36±12.15
E_1	8	143.17±7.08	4.65±0.48	8.18±0.38	1.91±0.21	98.16±11.02
ΔX_1		+ 2.45	+ 0.42	- 1.05	- 0.06	+ 3.80
E_2	8	137.18±3.12	5.39±0.18	8.05±0.30	1.68±0.06*	111.15±10.24*
ΔX_2		- 3.54	+ 1.16	- 1.18	- 0.17	+ 16.79

n – number of animals * $P < 0.01$

In animals of group E_1 - occasional alcohol consumption, we found an increase of serum sodium, potassium and iron level. Calcemia and magnesiemia showed a mild decrease. In case of chronic administration of ethanol - animals of goup E_2, the results revealed decreased values for sodium, calcium, magnesium while potassium and iron increased. The observed increase is in accordance with other literature data (Matti Välimäki et al., 1983; Friedman et al., 1988; Precob et al., 2000). Literature date state that in adults, alcohol alters iron metabolism predisposing to excess hepatic iron storage and, possibly, liver damage.

CONCLUSIONS

1. Studies regarding the concentration of triglycerides and HDL-cholesterol, LDL-cholesterol in blood serum of laboratory animals are very important for defining the influence of ethanol consumption on health status.
2. Serum triglycerides concentration is higher in experimental E_1 and E_2 groups as compared to control, and more precisely, in case of chronic administration (E_2) is higher than in occasionally consumption (E_1).
3. HDL-cholesterolemia and LDL-cholesterolemia were increased in animals from the experimental groups as compared to control group, i.e. higher in case of chronic administration (E_2), revealing the hepatotoxic effect of ethanol
4. Serum metal ions concentration revealed homeostasis changes in animals of E_1 group, mild increase of most of the studied metals, excepting calcium. Serum levels of sodium, calcium and magnesium showed a decrease in animals with chronic ethanol administration of E_2 group, while the concentration of K and Fe increased.

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