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Gender-dependent alteration of metal element homeostasis after one-month of red wine consumption

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SUMMARY

Women are significantly more sensitive to the oxidative stress caused by alcohol and their risk of liver cirrhosis is three times higher compared to men. Changes of element status involves in cirrhotic process. Our aim was to examine the changes of element homeostasis after regular red wine input of healthy young adults.

Serum samples of 10 men and 9 women (age: 20–25 years) were measured before and after red wine consumption (men: 300 ml/day; women: 200 ml/day; for a month). Routine chemical parameters were determined from serum. Element content was measured from erythrocytes.

In the case of routine parameters no significant difference was found between men and women before and after the red wine input. The concentration of Ca, Pb and Sr was significantly decreased after wine consumption in both sexes, while the elimination of Mg and Zn from erythrocyte was observed only in female patients. Already the one-month regular red wine input influences the element homeostasis of the organism, and females react more sensitively even to the input of a small amount. The work was supported by the ETT 012/2006 program.

Keywords: gender-dependence, metal element homeostasis.

Introduction

Several scientific works present that moderate dose red wine consumption is associated with reduced cardiovascular disease mortality (*Stanley* and *Mazier* 1999). Plasma antioxidant capacity increased significantly after high doses of red wine, but not after de-alcoholized red wine consumption, despite similar amounts of phenolic substances (*Kiviniemi et al.* 2007).
In Hungary a lot of people are suffering from alcoholic liver cirrhosis in relative early ages. The main problem is the stabile drinking habit of the centuries in relation to the changed food eating habits and the different manner of living. More and more women have alcoholic liver diseases and their drinking habit resembles to a man's.
Changes of metal element concentration can be observed in several diseases e.g. cardiovascular diseases as well as fatty liver (*Szentmihályi et al.* 2000a). Therefore the aim of our study was to establish the effect of systematic and moderate red wine consumption concerning element homeostasis with no controlled feeding of young adult male and female student volunteers during a one-month period.

Methods and materials

Patients: A total of 19 (male: 10; females: 9) Caucasian nondrinker or rare moderate wine drinker (< 250 ml per week) volunteers, all apparently healthy, with an average age of 25 ± 3 years and body mass index (BMI) of 23.6 ± 2.5 kg/m^2 were drawn into the project. None of the individuals had a history of acute or chronic coronary artery diseases, severe liver or kidney diseases, alterations of glycaemic (with blood glucose > 5,5 mmol/l) or lipid metabolism (with total cholesterol > 6 mmol/l or triglycerides > 2 mmol/l).
Men got 300 ml and women got 200 ml daily input for a month from Egri Cuvée red wine (Hungary) available also in commercial trade. Permission number: TUKEB 69/2000.
Red wine: The wine sample consumed by patients had significant amount of resveratrol (12.03 mg/l), which is 3–4 times higher compared to other wine samples (3.14 mg/l; *Perrone et al.* 2007).
Laboratory measurements: Routine laboratory tests were determined immediately with Roche metods by Hitachi Modular and with Bayer method by Advia 120.
Erythrocytes were separated using standard methods. The hemoglobin content was adjusted to 1 g% uniformly for the measurements.
Measurement of element content: The element content of wine was measured with a inductively coupled plasma optical emission spectrometer (ICP-OES, Spectro Genesis) after alcohol evaporation and digestion. The element content of erytrocytes was measured with Spectro Genesis ICP-OES after digestion of the samples in a mixture of HNO_3 (5 ml) and H_2O_2 (3 ml) (*Szentmihályi et al.* 2000b).
Statistical analysis: Mean values and standard deviations (SD) were calculated from the results. For comparison of the means, one way analysis of variance (ANOVA) was used by GraphPAD software version 1.14 (1990). Significance limit was $P < 0.05$.

Table 1. Element concentration (μg/ml) in red wine

	Mean	SD		Mean	SD		Mean	SD		Mean	SD
Al	0.817	0.004	**Co**	<0.003		**Mg**	99.85	6.02	**Pb**	0.032	0.021
Ba	0.133	0.004	**Cr**	<0.004		**Mn**	1.22	0.01	**S**	451.5	1.2
B	2.99	0.036	**Cu**	0.277	0.004	**Na**	8.03	0.21	**Sr**	0.548	0.048
Ca	79.57	3.27	**Fe**	10.67	0.263	**Ni**	<0.005		**Ti**	0.0028	0.0001
Cd	<0.002		**K**	887.9	45.9	**P**	211.3	15.1	**Zn**	0.642	0.0178

Results

The Egri Cuvée is also rich in elements since the concentration of Ba, Mn, P and Sr are higher than in Hungarian red wines in general. The other element concentrations are in good agreement with literature data.

There was no observed connection between the element content of wine and the element content in erythrocytes after wine consumption. The consumption of wine and alcohol effects on female and male patients in different ways as it can be seen in *Table 2*. While in both sexes the concentration of Ca, Pb and Sr decreased significantly ($p < 0.05$), the significant decrease of Mg and Zn concentration was measured only in famale patients.

Table 2. Element content (μg/ml) in patients before and after consumption of wine

	Female before red wine	Female after red wine	Male before red wine	Male after red wine
Al	0.6405 ± 0.3054	0.5060 ± 0.1455	0.6926 ± 0.2069**	0.4150 ± 0.0938**
Ba	0.6010 ± 0.1399	0.6174 ± 0.1155	0.6469 ± 0.0863	0.5788 ± 0.1018
Ca	4.17 ± 2.16*	1.71 ± 0.377*	3.54 ± 0.89**	1.58 ± 0.51**
Cu	0.0855 ± 0.0366	0.0819 ± 0.0391	0.0839 ± 0.0368	0.0745 ± 0.0333
Fe	26.61 ± 6.48	25.67 ± 4.70	27.89 ± 3.34	26.36 ± 4.31
Li	0.1771 ± 0.0455	0.1628 ± 0.0406	0.1783 ± 0.0300**	0.1506 ± 0.0299*
Mg	1.798 ± 0.204*	1.552 ± 0.170*	1.825 ± 0.278	1.588 ± 0.261
Mn	0.0152 ± 0.0073	0.0407 ± 0.0814	0.0153 ± 0.0064	0.0115 ± 0.0025
P	19.05 ± 4.95	19.04 ± 4.54	19.35 ± 4.47	18.90 ± 3.84
Pb	0.2972 ± 0.3129*	0.1035 ± 0.0149*	0.1238 ± 0.0437**	0.0938 ± 0.0117**
S	54.85 ± 10.93	54.23 ± 8.60	56.78 ± 11.28	58.31 ± 6.67
Sr	0.0421 ± 0.0137*	0.0305 ± 0.0037*	0.0400 ± 0.0054**	0.0293 ± 0.00387**
Zn	0.5821 ± 0.2935*	0.4044 ± 0.0903*	0.3768 ± 0.1217	0.3579 ± 0.0664

* and ** significant change (< 0.05) by the effect of wine consumption compared to the initial concentration

Discussion

Epidemiological studies justify, that women are significantly more sensitive againt the oxidative stress caused by alcoholic beverages and their risk for liver cirrhosis is tree times

higher compared to men. In women, alcoholic complication and cirrhosis are developed in a shorter amount time than in the men. The lifetime of alcohol dependent women is shorter, although probability of primer tumor development is lesser, than in men (*Stein* and *Cyr* 1997, *Morgan* and *Sherloc* 1977).

Gender difference can be found in the pharmacokinetic of alcohol as well as in the ethanol metabolism. (*Kwo et al.* 1998, *Niemela et al.* 1999). The acetaldehyde dehydrogenase 6 gene (ADH6) has got hormonsensitive elements. It was established, that the androgen hormones diminished and progestin and oestrogen increased the activity of cytosolic ADH in animal experiments (*Yoshida* 1994). The activity of alcohol dehydrogenase in the stomach is very low in women, therefore the first pass reaction is not enough for the rapid elimination of alcohol (*Frezza et al.* 1990). Fukunaga and coworkers found, that the acetaldehyde concentration of women blood was significantly high, while this activity could not be detectabled in men (*Fukunaga et al.* 1993). In animal experiments gender difference was found concerning immunoreactivity. Immune reactivity was more intensive in female animals than in male ones (*Yamada et al.* 1999). In other studies, alcohol increased the rate of CD4 + (T-helper cells) in male animals, although the secretion of IgM and IgG was increased in female animals (*Grossmann et al.* 1993). Difference can also be found in the lipid metabolism during alcohol consumption between genders. Alcohol inhibits the □-oxidation of fatty acids in the mitochondria, therefore □-oxidation of microsomes and □-oxidation of peroxisomes are increased as compensatoric effects. These compensatoric mechanisms were not functioning sufficiently in women therefore lipid accumulation in the liver was more frequent than in man (*Ma et al.* 1999). In our examinations in the case of routine parameters no significant difference was found between male and female blood samples before and after the red wine input. Already the one-month regular red wine input influences the element status of the organism, and that of females react more sensitively even to the input of a small amount. Therefore we have to concentrate on the earlier instruction of young people against systematic consumption of alcoholic beverages.

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