



## THE CHANGES IN BIOCHEMICAL PARAMETERS DUE TO WINE CONSUMPTION DEPENDING ON GENDER

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### ABSTRACT

The aim of this study was to investigate the effect of red wine consumption on the lipid profile and glucose in the group of male (13 men aged 34 – 64 years) and the group of female (11 women aged 28 – 57 years). Research consisted of moderate red wine consumption for 6 weeks. The dose of alcohol ranged from 200 to 300 mL per day of red wine Lemberger (Winery Masaryk, Slovakia). The blood samples were obtained after overnight fasting and were collected at baseline and after three days, three weeks and six weeks of wine consumption. Differences between male and female subjects were reflected in the results of different biochemical parameters in the dynamics of wine consumption. We found out that while in females the total cholesterol level did not change significantly and had a predominantly downward trend, for male subjects we observed at the beginning the slight increase of the levels, which, however, after 6 weeks of consumption significantly decreased from an initial value of  $5.75 \pm 1.32 \text{ mmol.L}^{-1}$  to  $5.35 \pm 1.25 \text{ mmol.L}^{-1}$  ( $p < 0.05$ ). The blood concentration of triglycerides in the dynamics of the experiment did not change significantly in either one gender, although small differences were observed, because while the female subjects had triglyceride development over consumption upward trend in male subjects it was vice versa. LDL-cholesterol changed significantly only in the group of female. Level of this lipid parameter decreased significantly during the six weeks of consumption of Lemberger from an initial value  $3.37 \pm 0.68 \text{ mmol.L}^{-1}$  to the lowest  $2.99 \pm 0.61 \text{ mmol.L}^{-1}$ , which was recorded in the third week of consumption ( $p < 0.0001$ ), but statistically significant differences versus baseline we monitored after three days and six weeks of consumption ( $p < 0.01$ ). In the group of male, we did not observe such significant changes, but it should be noted, that the men had changes in LDL-cholesterol downward direction and all the values were in the range of benchmarks. In the group of female, HDL-cholesterol increased to  $2.05 \pm 0.6 \text{ mmol.L}^{-1}$  after six weeks of consumption from baseline of  $1.7 \pm 0.69 \text{ mmol.L}^{-1}$ , and the difference was statistically significant ( $p < 0.05$ ), in the group of male, its level changed first significantly after three days of consumption of steep increase ( $1.46 \pm 0.61 \text{ mmol.L}^{-1}$ ,  $p < 0.05$ ), and for the next six weeks, it was the significantly increase ( $1.59 \pm 0.5 \text{ mmol.L}^{-1}$ ,  $p < 0.01$ ). The glucose concentration did not change significantly in the dynamics of wine consumption among men and women, and all the values were between the limits of the standard.

**Keywords:** red wine; alcohol; health; gender

### INTRODUCTION

Among the wine experts as the best wines in the world they consider French, Italian and German white wines. Slovak vineyards also offer a wide range of wine grape varieties from which it is possible to produce high-quality and fine wines. Even the results of our measurements confirm (Gažarová et al., 2008), the Slovak dry red and white wines contain health-promoting substances which are not only comparable with quality foreign wines, but in some cases, greater than. It is proved by the content of the total polyphenols, especially specific substances such as trans-resveratrol, quercetin and anthocyanins in red wines. In addition, Slovak wines have significant anti-radical capabilities, which allow them to compete with high-quality foreign wines.

Various mechanisms are involved in the development of fatal and non-fatal coronary heart diseases and other vascular diseases, including inflammatory and oxidative stress, that leading to hypertension, diabetes and other risk

factors that accelerate atherosclerosis. The creation of conditions preventing the overproduction of a toxic accumulation of free radicals becomes the foundation for both the prophylaxis and also in enhancing the effectiveness of treatment of lifestyle and civilization diseases including cardiovascular diseases. Red wine provides alcohol and polyphenolic compounds. The beneficial effects of moderate red wine consumption may be attributed to the overall mix of its components and not to one in particular – the alcoholic fraction increases HDL-cholesterol, non-alcoholic fraction (polyphenolic compounds) inhibits the oxidation of LDL particles, improvements of endothelial function, blood lipid profile and decreases blood pressure (Tsang et al., 2005; Karatzi et al., 2009; Xin et al., 2010; Costanzo et al., 2011).

In the last decades, wine is the subject of various studies, while it is monitored not only the short-term but also the long-term effects of wine consumption in the relation to the various diseases. Many of these studies not only

suggest but even confirm the beneficial effects of wine on human health compared to other alcoholic beverages. Also other authors (Renaud and de Lorgeril, 1992; Mosinger, 1994; Marques-Vidal et al., 1995; Carbonneau et al., 1998; Serafini et al., 1998; Paganga et al., 1999; Gorinstein et al., 2000; Gronbaek et al., 2000; Klatsky et al., 2003; Renaud et al., 2004) share the same opinion based on their research, that among the alcoholic beverages the red wine is the most effective against atherosclerosis.

Numerous epidemiological studies observed a J-shaped relationship between increasing wine consumption and cardiovascular risk (Fuller, 2011; Rostron, 2012), low HDL-cholesterol, high triglycerides (Park and Kim, 2012). Meta-analyses of cohort studies confirmed a U-shaped relationship between alcohol intake and type-2 diabetes (Koppes et al., 2005; Baliunas et al., 2009). Moderate alcohol consumption is up to 30 g alcohol.day<sup>-1</sup> for men and 10 – 15 g alcohol.day<sup>-1</sup> for women. Different amounts of alcohol have different health benefits according to gender. Some studies suggest that the beneficial effects of alcohol consumption are higher in men than in women (Xin et al., 2001), but many studies show similar effects in both genders (Mukamal et al., 2005). Lorková et al., (2015) found that the most preferred alcoholic beverages among men were beer and wine and among women wine and liqueurs. The regular use of alcohol was reported by 55.35% of men and 33.4% of women consume 0.2 – 0.5 liters of alcoholic beverage per week. Bellavia et al., (2014) found that women with alcohol intake of 5 – 10 g.day<sup>-1</sup> had lower risk of cardiovascular diseases and cancer mortality and men with alcohol consumption of 15 – 20 g.day<sup>-1</sup> had lower only risk of cardiovascular diseases mortality.

At some stage of life, male's and female's organism works under the influence of several different factors. This can be mostly reflected the different health based on gender. In the case of civilization diseases, one gender is more prone to one type of disease, while the opposite gender turns into a different type of diseases. Morphologically and physiologically there are some differences between the genders that can play an important role in the development and predisposition to certain diseases. Framingham study data showed a lower incidence of cardiovascular disease events among premenopausal women compared with postmenopausal women (Kannel, Hjortland and McNamara 1976). Premenopausal women represent a specific part of the population due to the effect of female sex hormone estrogen, which protect them from the cardiovascular disease by reducing this risk, while in the case of male sex hormones androgens opposite is true. It means that premenopausal women are on average at substantially lower risk of premature cardiovascular disease than men of the same age. An adverse effect of menopause on cardiovascular diseases risk is explained by the deterioration of the lipid profile towards postmenopause (Matthews et al., 2009). This is reflected in increasing levels of total cholesterol, LDL-cholesterol and triglycerides and the reduction of HDL-cholesterol (Anagnostis et al., 2015).

Since the consumption of alcoholic beverages is associated with the risk of both cardiovascular and other

civilization diseases, it seems interesting to observe the effect of the consumption of the Slovak dry red wine Lemberger to the individual biochemical, anthropometric and clinical indicators depending on gender. Based on this fact, we investigated the effect on female subjects, and especially in male subjects.

## MATERIAL AND METHODOLOGY

The aim of this study was to investigate the effect of red wine consumption on the lipid profile and glucose in the group of male and the group of female. Research consisted of moderate red wine consumption. 1 – 3 glasses of red wine at dinner after day of abstinence were administered to 24 healthy volunteers (13 men aged 34 – 64 years - mean age 51 years and 11 women aged 28 – 57 years - mean age 45 years) for 6 weeks. The dose of alcohol ranged from 200 to 300 mL per day of red wine Lemberger (Winery Masaryk, Slovakia). Most of the subjects were categorized in the group at high risk for cardiovascular complications. The participants were carefully instructed to abstain from any pharmacological treatment and all of the volunteers were asked to maintain their habitual diets and lifestyles during the 6 weeks of the study. The blood samples were obtained after overnight fasting and were collected at baseline (1st blood sampling) and after three days (2nd blood sampling), three weeks (3rd blood sampling) and six weeks (4th blood sampling) of wine consumption. Serum and EDTA-plasma were collected and stored at the temperature -80 °C. A total fasting blood sample was collected to assess a total cholesterol, low-density lipoprotein (LDL-C), high-density lipoprotein (HDL-C), triglyceride and glucose. A written informed consent to participate in the study was provided to all subjects involved in the study after they were informed of all risks, discomforts and benefits. The Ethic Committee at the Specialized Hospital St. Zoerardus Zobor, n. o. approved the study protocol. All the biochemical parameters were analyzed at the Department of Human Nutrition at Slovak University of Agricultural using the selective multiparameter analyzer LISA 200. The results were evaluated with standard mathematical-statistical methods (STATISTICA Cz, MS Excel 2007). Differences were tested with the *t*-test, Tukey and Fisher test. The results were listed in the Table 1 and Table 2.

## RESULTS AND DISCUSSION

Differences between male and female subjects were also reflected in the results of different biochemical parameters in the dynamics of wine consumption. Cholesterol is one of the basic compounds essential for cells life. Its blood concentration is relatively stable through dietary intake restrictions, a change in its concentration evident only after a long time. The reference values for the optimum cholesterol levels range from 3 to 5.2 mmol.L<sup>-1</sup>. In the lipid profile, we found out that while in females the total cholesterol level did not change significantly and had a predominantly downward trend, for male subjects we observed at the beginning the slight increase of the levels, which, however, after 6 weeks of consumption statistically significant decreased from an initial value of 5.75 ±1.32 mmol.L<sup>-1</sup> to 5.35 ±1.25 mmol.L<sup>-1</sup> (*p* <0.05). For both, male and female group, the total cholesterol levels remained

above the upper limit of normal reference values. Similar results reached the authors **Basu et al., (2006)**.

Triglycerides do not interfere in the process of atherogenesis, but the elevated levels point at the increased levels of fatty substances and certain lipoproteins in the blood. The optimum range of blood triglyceride values is from 0.2 to 1.92 mmol.L<sup>-1</sup>. The blood concentration of triglycerides in the dynamics of the experiment did not change significantly in either one gender, although small differences were observed, because while the female subjects had triglyceride development over consumption upward trend in male subjects it was vice versa. It is also important to stress that while triglyceride levels in women ranged within the normal range, men had all values above the upper critical threshold. The negative effect of alcohol consumption is the increase in triglycerides. **Cesena et al., (2011)** reported that red wine increased plasma levels of triglycerides and the triglycerides/HDL-C ratio and those individuals with higher BMI were at higher risk for elevation in plasma triglycerides. Although fasting levels of triglyceride have been shown to increase in some experimental observations, the change is minor compared with increases in HDL (**Leighton and Urquiaga, 2007**).

To determine the risk of atherosclerosis it is not as important total cholesterol, but in particular the binding to the various types of lipoproteins and their concentrations in blood. It is proved the direct dependence between serum levels of LDL-cholesterol and mortality from cardiovascular diseases. The optimal level of LDL-cholesterol is in the range from 0 to 3.9 mmol.L<sup>-1</sup>. In the cardiovascular prevention the reduction of LDL-C by 1% results in a reduction in the risk of coronary heart disease by 1%. Every reduction in LDL-C by 1 mmol.L<sup>-1</sup> (~40 mg.dL<sup>-1</sup>) leads to the corresponding 22% reduction in cardiovascular mortality and morbidity in patients with risk. In general, the US national recommendations advise the following reference values for serum lipids: (total cholesterol <200 mg.dL<sup>-1</sup>, triglycerides <150 mg.dL<sup>-1</sup>, LDL-C <130 mg.dL<sup>-1</sup> and HDL-C >40 mg.dL<sup>-1</sup>). Extrapolated from the clinical studies overall reduction in LDL-cholesterol below <1.8 mmol.L<sup>-1</sup> (less than ~70 mg.dL<sup>-1</sup>), or at least 50% has the largest benefit in terms of the decrease of cardiovascular diseases. In patients with a very high cardiovascular risk is the therapeutic target of LDL-C value <1.8 mmol.L<sup>-1</sup> or more than 50% decrease from baseline. In patients with high cardiovascular risk a target LDL blood value is <2.5 mmol.L<sup>-1</sup> and in patients with moderate risk <3 mmol.L<sup>-1</sup> (**ESC Pocket Guidelines**). In our study, LDL-cholesterol changed significantly only in the group of female. Level of this lipid parameter significantly decreased during the six weeks of consumption of Lemberger from an initial value 3.37 ±0.68 mmol.L<sup>-1</sup> to the lowest 2.99 ±0.61 mmol.L<sup>-1</sup>, which was recorded in the third week of consumption ( $p < 0.0001$ ), but statistically significant differences versus baseline we monitored after three days and six weeks of consumption ( $p < 0.01$ ). In the group of male, we did not observe such significant changes, but it should be noted, that the men had changes in LDL-cholesterol downward direction and all the values were in the range of benchmarks. **Kanner et al., (2012)** found that LDL-C was slightly reduced after red wine

consumption. The same decline also observed **Shai et al., (2004)**; **Micallef, Lexis and Lewandowski (2007)** and **Joosten et al., (2008)**.

HDL-cholesterol is considered to be a long-term protective factor for the development of cardiovascular diseases. The total level of HDL-C is inversely associated with the risk of the developing coronary heart disease and an increase in HDL-C by 0.39 mmol.L<sup>-1</sup> results in a risk reduction by 22%, and every increase in HDL-C by 1% results in a reduction in the risk of coronary heart disease by 2 – 3% (**Sabaka et al., 2012**). When we assessed changes in levels of "good" HDL-C in the dynamics of consumption of Lemberger we found out that values were changed very beneficially in both genders in the direction of a positive increase, but in group of male reflected these changes significantly. In the group of female, HDL-C increased to 2.05 ±0.6 mmol.L<sup>-1</sup> after six weeks of consumption from baseline of 1.7 ±0.69 mmol.L<sup>-1</sup>, and the difference was statistically significant ( $p < 0.05$ ), in the group of male, its level changed first significantly after three days of consumption of steep increase (1.46 ±0.61 mmol.L<sup>-1</sup>,  $p < 0.05$ ), and for the next six weeks, it was the significantly increase (1.59 ±0.5 mmol.L<sup>-1</sup>,  $p < 0.01$ ). This positive upturn described most authors dealing with this topic (**Gaag et al., 1999**; **Estruch, 2000**; **Devaraj et al., 2002**; **Shai et al., 2004**; **Sierksma et al., 2004**; **Joosten et al., 2008**). **Brien et al., (2011)** reported that moderate red wine consumption increased HDL-C. **Leighton et al., (2000)** showed that 30 g of alcohol a day would cause an average increase of 8.3% in HDL levels. **Leighton and Urquiaga (2007)** observed increases in HDL-C ranging between 4% and 18% among wine consumers and red wine appeared to be slightly better than white wine.

Although women should be more protected against cardiovascular risk, but there are also other factors to eliminate this benefit of women, for example diabetes mellitus. In this regard, monitoring of the impact of dry red wine intake on blood glucose changes has been very interesting. After evaluating the results we observed that the level of glucose in the dynamics of consumption did not change significantly in either men or women and that all the values were between the limits of the standards. After 3 days of wine consumption we observed a slight increase in its levels in both genders, which in the next weeks in women returned back to the level of initial value (4.93 ±0.45 mmol.L<sup>-1</sup> vs baseline 4.91 ±0.47 mmol.L<sup>-1</sup>) and in men even lower (5.54 ±0.91 mmol.L<sup>-1</sup> of 5.72 ±0.87 mmol.L<sup>-1</sup>). A U-shaped relationship between alcohol consumption and risk of type-2 diabetes has been confirmed (**Koppes et al., 2005**; **Baliunas et al., 2009**). Several studies have suggested that moderate alcohol intake reduces the risk of type-2 diabetes by 20 – 40% (**Joosten et al., 2010**; **Sato et al., 2012**; **Shi et al., 2013**). **Rasouli et al., (2013)** reported that high consumers had similar risk to abstainers. **Heianza et al., (2013)** reported a higher risk of type-2 diabetes among binge drinkers and **Cullmann, Hilding and Ostenson (2012)** found a higher type-2 diabetes risk among heavy consumers. **Chiva-Blanch et al., (2013)** found that red wine with or without alcohol improved metabolism of glucose. **Rasouli et al., (2013)** found that consumption of wine has been linked to reduced diabetes risk.

**Table 1** Changes of biochemical parameters in group of male.

Parameters	Reference standard	Baseline	3 day-consumption	p-value	Significance	3 week-consumption	p-value	Significance	6 week-consumption	p-value	Significance
Total cholesterol (mmol.L <sup>-1</sup> )	3 – 5.2	5.75 ±1.32	5.98 ±1.34	0.247	-	5.94 ±1.29	0.320	-	5.35 ±1.25	0.046	+
Triglycerides (mmol.L <sup>-1</sup> )	0.2 – 1.92	2.31 ±1.36	2.55 ±1.73	0.502	-	2.17 ±1.24	0.699	-	1.78 ±0.66	0.141	-
HDL-C (mmol.L <sup>-1</sup> )	1.16 – 1.6	1.19 ±0.49	1.46 ±0.61	0.014	+	1.58 ±0.71	0.001	++	1.59 ±0.50	0.001	++
LDL-C (mmol.L <sup>-1</sup> )	0 – 3.9	3.53 ±0.92	3.34 ±0.91	0.128	-	3.36 ±0.81	0.168	-	3.37 ±0.89	0.183	-
Glucose (mmol.L <sup>-1</sup> )	3.9 – 6.1	5.72 ±0.87	5.99 ±0.70	0.079	-	5.76 ±0.71	0.787	-	5.54 ±0.91	0.235	-

**Table 2** Changes of the biochemical parameters in a group of female.

Parameters	Reference standard	Baseline	3 day-consumption	p-value	Significance	3 week-consumption	p-value	Significance	6 week-consumption	p-value	Significance
Total cholesterol (mmol.L <sup>-1</sup> )	3 – 5.2	5.55 ±0.88	5.5 ±1.09	0.797	-	5.3 ±0.83	0.232	-	5.37 ±0.79	0.377	-
Triglycerides (mmol.L <sup>-1</sup> )	0.2 – 1.92	0.94 ±0.34	1.08 ±0.48	0.380	-	1.2 ±0.55	0.102	-	1.11 ±0.44	0.263	-
HDL-C (mmol.L <sup>-1</sup> )	1.16 – 1.6	1.7 ±0.69	1.9 ±0.58	0.197	-	2.01 ±0.81	0.047	+	2.05 ±0.6	0.027	+
LDL-C (mmol.L <sup>-1</sup> )	0 – 3.9	3.37 ±0.68	3.08 ±0.76	0.001	++	2.99 ±0.61	<0.0001	+++	3.14 ±0.58	0.009	++
Glucose (mmol.L <sup>-1</sup> )	3.9 – 6.1	4.91 ±0.47	5.08 ±0.45	0.296	-	4.93 ±0.52	0.916	-	4.93 ±0.45	0.880	-

## CONCLUSION

As mentioned above and in many other researches it is therefore clear that wine is much richer in content of nutrients and natural products beneficial for the human body than expected. Its consumption, if it is drunk sensibly and in moderation, is not harmful to the human body and forms an appropriate part of the diet and is beneficial for health. It should be taken into consideration that the moderate consumption of alcohol is recommended to the healthy people. It is necessary to fight against excessive and inappropriate consumption of alcoholic beverages and therefore the wine and it is needed to drink it in moderation. Although everyone has different opinions on what is moderate drinking, the fact is that wine is fine, and therefore deserves the noble usage and use only to the extent that it has a pleasant effect and benefit to our body and strengthened the health because drinking too much wine is harmful to the human body!

We found out that during consumption of red wine the serum of total cholesterol did not change significantly and had a predominantly downward trend in the group of female. In the group of male, we initially observed a slight increase in the levels, which after 6 weeks of consumption statistically significantly decreased. Total cholesterol levels in both genders, we found above the upper range of reference values. The level of triglycerides in the dynamics of the experiment did not change significantly in either one gender, although there were observed small differences. In female subjects had changed in triglycerides upward trend, in male subjects it was just the opposite. In contrast to

women, in men all values of triglycerides were above the upper limit of normal. LDL-cholesterol was significantly changed only in women whose levels decreased significantly. Changes in LDL-cholesterol in group of male had downward direction, although statistically not significant, and all the values were in the range of benchmarks. HDL-cholesterol in both genders in the dynamic of consumption of Lemberger was changed very favorably in the direction of a positive increase, but in male subjects reflected to these changes significantly. Women should be more protected against cardiovascular disease, but there are impacts that eliminate this benefit of women, such as diabetes mellitus. Diabetes increases the risks of heart attack, stroke and other complications of the atherosclerosis in women much more than in men. It is therefore favorable fact that the glucose concentration did not change significantly in the dynamics of wine consumption among men and women, and all the values were between the limits of the standard.

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**Acknowledgments:**

This work was supported by grants VEGA no. 1/0127/14, ITEBIO (ITMS 26220220115), ECOVA PLUS (ITMS 26220120032).

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