Red Wine and Cardiovascular Health

Huige Li and Ulrich Förstermann*
Department of Pharmacology, Johannes Gutenberg University Medical Center, Mainz, Germany

Editorial on:
Dealcoholized Red Wine Decreases Systolic and Diastolic Blood Pressure and Increases Plasma Nitric Oxide
Chiva-Blanch et al.
_Circ Res._ 2012. DOI: 10.1161/CIRCRESAHA.112.275636

*Correspondence: Ulrich Förstermann, Department of Pharmacology, Johannes Gutenberg University Medical Center, Obere Zahlbacher Strasse 67, 55131 Mainz, Germany. E-mail: ulrich.forstermann@uni-mainz.de

Short title: Red Wine Polyphenols and Cardiovascular Health

Key word: red wine, polyphenols, alcohol, blood pressure

The opinions expressed in this article are not necessarily those of the editors or of the American Heart Association.
There is strong epidemiological evidence that light-to-moderate consumption of alcoholic drinks, but neither zero nor more than moderate intake, reduces mortality from all causes and also diminishes cardiovascular risk. The lowest risk for coronary heart disease mortality is seen with 1–2 drinks (12.5-25 g alcohol) per day.

Hypertension is a major risk factor for cardiovascular disease, and there is a clear inverse relationship between light-to-moderate alcohol intake and blood pressure. Thus, the reduced cardiovascular risk associated with moderate consumption of alcoholic drinks may be due – in part – to a reduction in blood pressure. The greatest blood pressure benefit seems to be obtained with one drink per day for women and with two drinks per day for men.

In most published studies, red wine has been used as the alcoholic test beverage. Red wine produces concentration-dependent vasodilator effects in subcutaneous small resistance arteries obtained from patients with essential hypertension. In addition, red wine and dealcoholized red wine increase flow-mediated vasodilatation (FMD) of the brachial artery in healthy subjects. Intake of red wine also counteracts endothelial dysfunction produced by high fat diet in human volunteers, and red wine increases FMD and decreases blood pressure in adult cigarette smokers.

Alcohol versus polyphenols in red wine

With red wine, both the alcoholic and the polyphenolic components seem to contribute to its beneficial effects. The alcoholic component is known to increase HDL cholesterol and to decrease fibrinogen concentrations. The polyphenols present in red wine have been shown to provide beneficial effects by inhibiting pro-oxidant enzyme systems and by stimulating antioxidant enzyme systems in the vasculature. In addition, wine polyphenols inhibit platelet aggregation, attenuate vascular inflammation and improve endothelial function.

In the current issue of Circulation Research, Chiva-Blanch et al. demonstrate in a small prospective clinical study that a reasonable daily dose of dealcoholized red wine (275ml/day) decreases systolic and diastolic blood pressures. This finding is in agreement with previous findings showing that the vasodilator effects of red wine may be mediated – at least in part – by polyphenolic compounds. Also other nonalcoholic, polyphenol-rich beverages such as grape juice produce vasodilation (increase FMD) in healthy individuals.

Cardiovascular risk factors are associated with oxidative stress in the vasculature, due to an increased production and/or impaired inactivation of reactive oxygen species (ROS). Oxidative stress, particularly the increased vascular production of superoxide, rapidly oxidizes and inactivates bioactive nitric oxide (NO). In addition, there is evidence that persisting oxidative stress can render endothelial NO synthase (eNOS) dysfunctional such that it no longer produces NO, but superoxide. This is likely to represent the pathophysiological situations of the subjects participating in the current study by Chiva-Blanch et al. All of these individuals had several cardiovascular risk factors.

Red wine polyphenols reduce oxidative stress and increase bioactive NO in the vasculature

When the effects of three alcoholic beverages, red wine, beer and vodka, were compared in a recent study, only red wine provided protection against vascular oxidative stress. Indeed, red wine polyphenols seem to shield the vasculature by reducing ROS (e.g. by decreasing the expression of p22phox) and by inhibiting endothelin-1 expression. At the same time, red wine polyphenols have been shown to increase bioactive NO in the vasculature. Also other protective factors such as endothelium-derived hyperpolarizing factor (EDHF) are stimulated. In the current study of Chiva-Blanch et al., the decrease in blood pressure by dealcoholized red wine was associated with elevated plasma levels of nitrite and nitrate, the oxidation products of NO. Thus the study supports the notion that – also in man in vivo – polyphenolic compounds from red wine can improve the functionality and activity of eNOS and can increase vascular levels of NO. While a causal relationship between this
effect and the observed decrease in blood pressure appears plausible, it is not being demonstrated in the study of Chiva-Blanch et al. 11.

Resveratrol and more

Red wine is a complex mixture containing numerous phenolic compounds. This raises the question as to the chemical entities actually responsible for the beneficial effects. There is evidence that particularly the phytoalexin resveratrol can provide health benefits 19. Experimentally, many positive effects of red wine can be mimicked with (usually relatively high doses of) resveratrol 20. For instance, both red wine 21 and resveratrol 22 have been shown to enhance eNOS expression in cultured human endothelia cells. However, the effect of red wine cannot be explained by resveratrol alone; it is largely mediated by resveratrol (about 70%), but several other polyphenols and phenolic acids contribute 23. Also, both red wine and resveratrol enhance eNOS enzymatic activity. Whereas the effect of resveratrol on eNOS phosphorylation (and activation) mainly involves estrogen receptor-mediated activation of ERK1/2 24, the phosphorylation (and activation) of eNOS by phenolic extracts from red wine also involves the phosphatidylinositol 3-kinases (PI3K)/Akt pathway 25. Resveratrol has a low bioavailability 19. Therefore, many in vivo effects of red wine are likely to be attributable to resveratrol metabolites in concert with a number of other polyphenolic compounds (and possibly their metabolites).

Red wine and unresolved questions

The beneficial effects of red wine can be enhanced by a healthy diet. Indeed, a synergistic effect of red wine and green olive oil (both are components of the Mediterranean diet) on FMD has been demonstrated 26. The average moderate wine drinker is more likely to exercise, to be health conscious, and to be of a higher educational and socioeconomic status 9. Nevertheless, there is growing evidence, corroborated by the current study of Chiva-Blanch et al. 11, that chemical constituents present in red wine confer health benefits beyond alcohol and independent of potential confounding factors. However, numerous issues need to be resolved in order to clearly assess the preventive or therapeutic potential of red wine constituents. Specific chemical entities responsible for the beneficial effects have to be identified. In this context one has to realize, that there are probably major differences between different red wines, depending on the grape and the growing area 21. Pharmacological mechanisms leading to increases in vascular NO and other beneficial effects have to be elucidated, and it has to be clarified whether the decrease in blood pressure is causally related to the increased NO levels, or what other mechanisms may be involved.

Finally, the question whether white wine offers a similar benefit as red remains unresolved. White wine, which is usually fermented without skin and seeds, is missing many of the polyphenols (e.g. resveratrol, catechin, quercetin, etc.) mainly found in these parts of the grape. There are a few studies (compiled in 27) demonstrating superior effects of red vs. white wine on certain cardiovascular parameters. However, epidemiological evidence demonstrating a specific benefit of red over white wine is poor 27, and conclusive studies comparing the two are missing. In the long run, a prospective, randomized study would be needed to prove or drop the red-better-than-white hypothesis.
Sources of funding: Original work from our own laboratory contributing to this editorial was supported by the Collaborative Research Center (Sonderforschungsbereich) SFB 553, by individual grant LI-1042/1-1 from the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG), and by the Integrated Research and Treatment Center “Thrombosis and Hemostasis” (CTH) of the German Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung, BMBF, 01EO1003).

Disclosures: None

References


DOI: 10.1161/CIRCRESAHA.112.278705


Figure. Factors potentially contributing to the vasoprotective effects of red wine. The alcoholic component of red wine increases high density lipoprotein (HDL) cholesterol level and decreases fibrinogen concentrations. Polyphenols present in red wine independently inhibit platelet aggregation, enhance bioactive nitric oxide (NO), stimulate the formation of endothelium-derived hyperpolarizing factor (EDHF), reduce reactive oxygen species (ROS) generation and inhibit endothelin-1 (ET-1) expression.