

Functional effects of red wine and its specific ingredients on cardiac tissue and pulmonary vessels

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Background: Epidemiological studies show positive effects for red wine consumption at moderate levels with respect to cardiovascular disease. The aim of this study is to characterize potentially beneficial bioactive substances in red wine regarding their pulmonary arterial and myocardial effects. Additionally, we assess whether these biological effects are independent of the alcohol content of the wine.

Methods: Dose-dependent effects of bioactive substances contained in red wine such as caffeic-acid (CA), gallic-acid (GA), cis- and trans-resveratrol (cis/trans), as well as red wine and non-alcoholic red wine were assessed on human atrial trabeculae and murine pulmonary arteries. Trabeculae were electrically stimulated and gradually stretched to optimum preload. Developed force and twitch kinetics were analyzed.

Intrapulmonary arteries isolated from rat lungs were used in isometric tension measurements. Precontraction was achieved with the thromboxane receptor agonist U46619. Vessel relaxation is provided as percentage (%relaxation) of the contraction induced by U46619.

Results: All bioactive substances (CA, GA, cis, trans) showed a subtle increase in developed force and dF/dt_{max} in human atrial trabeculae compared to untreated control, indicative of a positive inotropic effect and fastened twitch kinetics (dev. F at 10^{-4} : CA: $124 \pm 8.6 \text{ mN/mm}^2$, GA: $123 \pm 7.6 \text{ mN/mm}^2$, cis: $111 \pm 4.7 \text{ mN/mm}^2$, trans: $112 \pm 4.5 \text{ mN/mm}^2$, ctrl: $86 \pm 7.4 \text{ mN/mm}^2$; $p < 0.05$ for CA; GA, cis, trans n.s). Furthermore, we tested two identical red wines, except the fact that one was the non-alcoholic counterpart. Both red wines significantly increased developed force compared to ctrl, however, the effect was attenuated with the non-alcoholic wine (red wine: $120 \pm 13.0 \text{ mN/mm}^2$, non-alcoholic: $95 \pm 4.5 \text{ mN/mm}^2$, ctrl: $85 \pm 7.4 \text{ mN/mm}^2$, $p < 0.05$; Figure).

We tested three red wines for their vasoactive effects on the properties of isolated pre-constricted intra-pulmonary arteries from rats. All three wines exerted a pronounced and sustained (60 minutes) vasodilatory effect (~80%). Additionally, the bioactive substances (cis-resveratrol, trans-resveratrol, KS, GS) were also tested on the same properties. Cis-resveratrol ($79.46 \pm 2.2\%$) and trans-resveratrol ($89.34 \pm 1.1\%$) showed maximum vasodilation compared to KS ($0.78 \pm 2.7\%$) and GS ($19.13 \pm 7.3\%$).

Conclusions: For the first time we showed direct positive inotropic effects of red wine and its bioactive substances on human atrial myocardium. Red wine promotes pulmonary artery relaxation, a beneficial effect largely attributed to the presence of resveratrol in both its cis and trans forms.



