Flavonoids in functional foods: potential to improve vascular function and cardiovascular health

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Background - Flavonoids are a class of compounds that occur in a wide variety of plant foods. A limited number of foods are particularly rich in flavonoids and can provide a significant contribution to flavonoid intake. These include tea, soy, red wine (derived from red grape skin and grape seeds), chocolate and several fruits. Isolated flavonoids derived from these flavonoid-rich plant foods can also be added to a food to produce a functional food. Flavonoids have been linked to better cardiovascular health. Accumulating data from population studies, studies using animal models, human intervention studies and in vitro studies suggest that a higher flavonoid intake can reduce the risk of cardiovascular disease. A major mechanism proposed involves effects to improve vascular function and lower blood pressure.

Population studies - Many prospective epidemiological studies have found an inverse relationship between flavonoid intake and risk of cardiovascular disease. Some studies have failed to show a benefit, which may be explained by either a uniformly low or high flavonoid intake within the populations studied. Overall, results of these studies suggest that flavonoids may provide modest protection against cardiovascular disease, but they do not establish a causal link.

Animal models of atherosclerosis - A causal link is supported by results of studies in animal models of atherosclerosis. Several studies have now shown that flavonoids, mainly from red grapes, can reduce the progression of atherosclerosis.

Human intervention studies - Results of human intervention trials provide further evidence for a causal link via effects on pathogenic pathways and risk factors for cardiovascular disease. The effects of flavonoids on a range of cardiovascular disease-related endpoints have been assessed in human intervention trials. Endpoints considered have included blood lipid and lipoprotein concentrations, endothelial function, arterial compliance and blood pressure, oxidative stress, platelet function and body fatness. For many of these, the data are inconsistent and/or limited.

Vascular function and blood pressure - Mostly consistent data from controlled trials does suggest that flavonoids can improve endothelial function and arterial compliance, and could reduce blood pressure in humans. The effects of flavonoids on endothelium-dependent flow-mediated dilatation in humans have been investigated in more than 10 randomised controlled trials in humans. Most of these trials have shown some improvement in endothelial function with flavonoids from sources including tea, red wine, red grape juice, and chocolate. Improvements in arterial compliance have also been observed with dietary flavonoids. Improved endothelial function and reduced arterial stiffness could play a role in blood pressure reduction. Studies on the effects of flavonoids on blood pressure provide varied results. Falls in blood pressure have been observed with increased flavonoid intake in some, but not all intervention studies. Results of cross-sectional population studies also support a relationship between higher flavonoid intake, particularly from tea, and lower blood pressure.

Conclusions - Overall, the evidence linking flavonoids with cardiovascular health is mounting, but is not yet conclusive. Effects of flavonoids to improve vascular function and reduce blood pressure could be at least partly responsible for any reduction in risk of cardiovascular disease. Further studies are needed to strengthen the evidence for these effects.