ABSORPTION OF ANTHOCYANINS FROM BLUEBERRIES AND SERUM ANTIOXIDANT STATUS IN HUMAN SUBJECTS

ABSORBȚIA ANTOCIANILOR ŞI ROLUL ANTIOXIDANȚILOR ÎN ORGANISMUL UMAN

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Abstract: *The present paper is a study about the role of anthochyaninis and other antioxidant status in human subject. Also is presented the mechanism of flavonoids metabolism pathways.*

Rezumat: *În această lucrare este studiat rolul antocianilor şi antioxidanților în organismul uman. De asemenea este prezentat mecanismul de acțiune al acestora.*

Key words: anthocyanins*, antioxidants, mechanism*
Cuvinte cheie*: quercitina, antioxidanți, mecanism.*

INTRODUCTION

Oxidative stress has been linked to cancer, aging, atherosclerosis, ischemic injury, inflammation and neurodegenerative diseases (Parkinson's and Alzheimer's). Numerous studies have demonstrated in vivo effects of flavonoid components from fruits and vegetables on various measures of oxidative cellular damage.

Antioxidants are compounds that protect cells against the damaging effects of reactive oxygen species, such as singlet oxygen, super oxide, peroxyl radicals, hydroxyl radicals and peroxynitrite. An imbalance between antioxidants and reactive oxygen species results in oxidative stress, leading to cellular damage.

Flavonoids may help provide protection against these diseases by contributing, along with antioxidant vitamins and enzymes, to the total antioxidant defence system of the human body.

Epidemiological studies have shown that flavonoid intake is inversely related to mortality from coronary heart disease and to the incidence of heart attacks.

MATERIALS AND METHOD

The flavonol quercetin (3,3, 4,5,7-pentahydroxyflavone) is one of the most abundant dietary flavonoids and has been one of the most frequently studied flavonoids. Data on the quercetin content of foodstuffs are limited, but the available data suggest a range of 2–250 mg quercetin/kg wet weight in fruits; 0–100 mg/kg in vegetables, with onions being especially high (200–600 mg/kg); 4–16 mg/L in red wine; 10–25 mg/L in tea; and 2–23 mg/L in fruit juices (35, 36). However, the extent of absorption of flavonoids such as quercetin is a critical issue relative to the many alleged health effects. Quercetin and other flavonoids have been shown to modify eicosanoid biosynthesis (antiprostanoid and anti-inflammatory responses), protect low-density lipoprotein (LDL) from oxidation (prevention of atherosclerotic plaque formation), prevent platelet aggregation (antithrombic effects), and promote relaxation of cardiovascular smooth muscle (antihypertensive, antiarrhythmic effects). In addition, flavonoids have been shown to have antiviral and anticarcinogenic properties.

Flavonoids are plant polyphenolic compounds ubiquitous in fruits, vegetables, and herbs. Flavonoids are primarily categorized into flavonols, flavones, flavanols, flavanones, and anthocyanidins. The daily intake of flavonoids in Western countries has been estimated to be between 0.5 and 1.0 g (4) but likely is much lower than this.

Reactive oxygen species from both endogenous and exogenous sources may be involved in the aetiology of diverse human diseases, such as coronary artery disease, stroke, rheumatoid arthritis, and cancer. Diets rich in fruits and vegetables are associated with a reduced risk for these pathologies (1–3), and protection has often been attributed to antioxidant vitamins such as vitamin C, vitamin E, and -carotene. Although fruits and vegetables are primary sources for these "nutrient" antioxidants, other dietary components may also be important protective agents.

Over 4,000 flavonoids have been identified, many of which occur in fruits, vegetables and beverages (tea, coffee, beer, wine and fruit drinks). The flavonoids have aroused considerable interest recently because of their potential beneficial effects on human health-they have been reported to have antiviral, anti-allergic, antiplatelet, anti-inflammatory, anti-tumor and antioxidant activities.

Flavonoids are polyphenolic compounds that are ubiquitous in nature and are categorized, according to chemical structure, into flavonols, flavones, flavanones, isoflavones, catechins, anthocyanidins and chalcones.

The oxidation of low-density lipoprotein (LDL) has been recognized to play an important role in atherosclerosis. Immune system cells called macrophages recognize and engulf oxidized LDL, a process that leads to the formation of atherosclerotic plaques in the arterial wall. LDL oxidation can be induced by macrophages and can also be catalyzed by metal ions like copper. Several studies have shown that certain flavonoids can protect LDL from being oxidized by these two mechanisms.

The hydrophilic antioxidant capacity of fruits and vegetables has been determined using the oxygen radical absorbance capacity assay. In general, the hydrophilic antioxidants account for more than 85% of the total antioxidants in fruits and vegetables, and antioxidant capacity of different fruits and vegetables may differ by a factor of 20-fold or more. This might suggest, from a standpoint of protecting against oxidative events in the body, that fruits or vegetables that have a higher antioxidant capacity should be more effective.

In some fruits, anthocyanins make a major contribution to the total antioxidant capacity. Dietary intake of anthocyanins may exceed 200 mg/d in individuals consuming several servings of fruit, but the "usual" intake is likely much less. The flavonols, and in particular quercetin, are ubiquitous in fruits and vegetables and contribute to antioxidant capacity. However, in some fruits or vegetables, there may be more than 100 compounds that can be separated by HPLC that can contribute to the measured antioxidant capacity. Thus, by narrowing our focus to a few compounds in this review, we may not be considering the full potential of fruits and vegetables.

The capacity of flavonoids to act as antioxidants depends upon their molecular structure. The position of hydroxyl groups and other features in the chemical structure of flavonoids are important for their antioxidant and free radical scavenging activities. Quercetin, the most abundant dietary flavonol, is a potent antioxidant because it has all the right structural features for free radical scavenging activity. The proposed pathways of quercetin absorption/metabolism are presented in figure 1.

Some common pathways of metabolism of flavonoids are emerging that can affect in vivo antioxidant capacity. Methylation in the 3-position of both cyanidin 3-glucoside and quercetin will decrease the antioxidant capacity of the metabolite. Further conjugation with glucuronide or sulphate may also affect antioxidant capacity depending on the position that is conjugated. Even though quercetin is conjugated during the absorption process, the conjugates still seem to retain antioxidant activity. Measurement of in vivo antioxidant effects of a single flavonoid compound appears to be difficult except at fairly high consumption rates. With whole foods, antioxidant effects may be more easily demonstrated, and the mixture or synergy between compounds in foods may have added benefit.

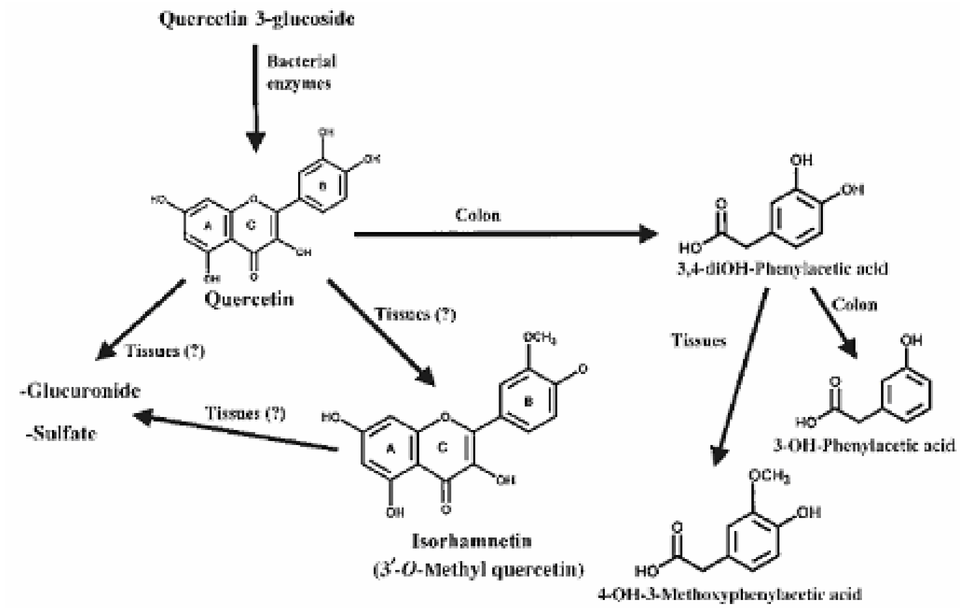

Fig. 1. Proposed pathways of quercetin absorption/metabolism

To assess the antioxidant activity of the prenylated flavonoids, we - in collaboration with LPI researchers - evaluated the capacity of these flavonoids to inhibit the oxidation of LDL by copper. The antioxidant properties of the prenylflavonoids were compared to those of quercetin (a flavonol), genistein (the major isoflavone in soy), chalconaringenin (a non-prenylated chalcone), naringenin (a non-prenylated flavanone), and vitamin E. The possible interaction of xanthohumol, the major prenylchalcone in beer, with vitamin E to inhibit LDL oxidation induced by copper was also examined. The observation that prenyl groups are important in conferring antioxidant activity to certain flavonoids may lead to the discovery or synthesis of novel prenylated flavonoids as preventive or therapeutic agents against human diseases associated with free radicals. Our encouraging results with xanthohumol suggest that this prenylchalcone should be further studied for its antioxidant action and protective effects against free radical damage in animals and humans.

CONCLUSIONS

In humans, anthocyanins appear to have some vasoprotective effects, but whether these are the result of antioxidant mechanisms is not clear. It is clear that under in vitro assay conditions, both anthocyanins and flavonols clearly can function as antioxidants.

In animal models, dietary anthocyanins at relatively high doses (1–2 mg/kg diet) are protective against oxidative stress.

However, in vivo, anthocyanin absorption appears to be at least an order of magnitude lower than for the flavonol quercetin. Whether anthocyanins get into cells or into an appropriate sub cellular compartment in sufficient concentrations to affect metabolic processes is not known.

LITERATURE

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