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Commentary

Food Interactions and Detoxification Pathway of Flavonoids

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DESCRIPTION

Flavonoids present over 5,000 hydroxylated polyphenolic compounds which carry out important functions in plants by attracting pollinating insects, combating environmental stresses by microbial infection and also helpful for regulating cell growth. Bioavailability and biological activities present in humans appear to be strongly influenced by its chemical nature. Since the 1990, interest was shown in dietary flavonoids due to their contribution to the health benefits of fruit and vegetable in rich diets.

Metabolism and bioavailability

The flavonoids present in ingested food have some importance. Dietary flavonoids are absorbed and become available to the target tissues within the body. After intestinal absorption, flavonoids are rapidly and extensively well metabolized in intestinal and also in liver cells such as metabolites in the bloodstream and urine. Biological activities of flavonoid metabolites are completely different from their parent compounds.

Chemical structure of flavonoids: Most flavonoids are seen in edible plants and foods as in the form of β-glycosides which bound to one or more sugar molecules. Exceptions include catechins, proanthocyanidins and fermented soy based products which are exposed to microbial β-glucosidases and they help to catalyze the release of sugar molecules from glycosylated isoflavones. After food processing and cooking most of flavonoid glycosides reach the small intestine. Only flavonoid aglycones and some of few flavonoid glucosides are easily absorbed in the small intestine. Glycosylated flavonoids might be able to penetrate into the mucus layer of the intestine and deglycosylated on the cell surface before its absorption. Those that cannot be deglycosylated in the small intestine may be hydrolyzed by using bacterial enzymes in the colon. Colonic bacteria remove sugar moieties and rapidly degrade aglycone flavonoids by limiting their absorption in the colon.

Monomeric flavan-3-ols, the polymeric nature of proanthocyanidins prevents their intestinal absorption. Flavan-3-ol monomers and procyanidins are transformed by using the intestinal microbiota to 5-(hydroxyphenyl)-γ-valerolactones which appear in the circulatory system and are excreted in urine as in the form of sulfate and glucuronide metabolites. Valerolactones are further degraded by the colonic microbiota into smaller phenolic acids and aromatic compounds. The colonic microbiota metabolizes the gallate esters of flavonoids by generating gallate which is further catabolized to pyrogallol. Microbe derived flavonoid metabolites are absorbed into the circulatory system and excreted in free forms.

Interactions with food matrix: Presence of macronutrients in food increases the bioavailability of flavonoids. The binding affinity and covalent interactions of flavonoids with proteins, carbohydrates, and fats are directly associated with the physicochemical properties of the flavonoids. Proteins present in milk might reduce the absorption of polyphenols from cocoa and black tea. Presence of proteins bound to flavonoids was weaken the flavonoid antioxidant capacity and milk consumption has been blunt the vascular benefits of tea flavonoids in people. Carbohydrate rich foods may increase the absorption of flavonoids by stimulating the gastrointestinal motility, mucosal blood flow, and colonic fermentation. Conversely, dietary flavonoids have been interfere with carbohydrate digestion and absorption.

Composition of gut microbiota: In large intestine, microbial enzymes transform flavonoids by deglycosylation, ring fission, dehydroxylation and demethylation methods into metabolites that can be absorbed or excreted. Diversity and activity of colonic bacteria which are partly dependent on dietary habits which will determine metabolites can be produced from ingested flavonoids. Composition of the colonic microbiota can affect the metabolic fate and bioavailability of dietary flavonoids.

The detoxification pathway: The flavonoids are recognized as xenobiotics by the body when they undergo extensive

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modifications in the intestinal mucosa and then followed by the liver.

Phase II enzymes: Depending on structural characteristics, flavonoids can be transformed by phase II detoxification enzymes to form the methylated, glucuronidated, and sulfated metabolites. This metabolic pathway increases the solubility of the phenolic aglycones and increases their excretion in the bile and urine. Free aglycones are generally absent in the bloodstream with the possible exception of trace levels of catechins. Catechol-O-Methyl Transferase (COMT) is an detoxifying enzyme responsible for an methylation of hydroxyl groups of flavonoids producing O-methylated flavonoids. Single nucleotide polymorphism in the gene causes a valine to methionine substitution in the sequence of an enzyme. It has been suggested that subjects who are less at eliminating green tea flavonoids may be more to benefit from their consumption.

CONCLUSION

Flavonoid bioavailability may be related to their binding affinity towards plasma proteins. Greater in binding affinity to plasma proteins has been linked to structural characteristics such as methylation and galloylation. Glycosylation reduce binding affinity to plasma proteins by suggesting that aglycones might have a limited bioavailability as compared to glycosylated flavonoids. While glucuronidation facilitate the excretion of flavonoids from the body then glucuronides show little affinity to plasma proteins and might be able to diffuse to target tissues where deglucuronidation can take place.