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Membrane interactivity shared by functional food components: One of mechanisms for diverse effects of flavonoids, terpenoids and alkaloids

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Background & Aim: In addition to nutritious significance, various foods exhibit the disease-preventive and health-maintaining functionality based on antioxidant, anticancer, antithrombotic, antibacterial, antinociceptive, anti-inflammatory effect, etc. In order to reveal the mechanism common to such diverse effects of functional foods, we studied the membrane interactivity of food component flavonoids, terpenoids and alkaloids to modify the membrane physicochemical property.

Methodology: Biomimetic liposomal membranes were prepared with phospholipids and cholesterol to mimic the lipid composition of biological membranes. Selected flavonoids, terpenoids and alkaloids were subjected to the reaction with membrane preparations and their induced changes in membrane fluidity were determined by measuring fluorescence polarization.

Findings: All the tested functional food components modified the fluidity of biomimetic membranes at nano- and micro-molar concentrations. Flavonoids and alkaloids decreased the membrane fluidity, whereas terpenoids increased. Their enantioselective membrane interactions to discriminate stereoisomers were obtained by increasing the composition of chiral cholesterol in membranes. The relative potencies of membrane interactions correlated to those of antioxidant, anti-proliferative and antiplatelet effects. The structure and activity relationship of flavonols indicated that 3'4'-dihydroxylation or no hydroxylation of the B ring and 5,7-dihydroxylation of the A ring produce greater membrane interactivity. In flavonols, a galloyl group at the 3-position was a determinant of membrane interaction. Flavonoids meeting these structural requirements showed the strongest biological effects.

Conclusion & Significance: The membrane interactivity is mechanistically associated with the diversity of pharmacological effects of food components. It would be a useful index for screening and evaluating the functionality of foods.

Biography

Hironori Tsuchiya received his PhD in Clinical Chemistry in 1984 from Gifu Pharmaceutical University where he studied high-performance liquid chromatography for the neonatal diagnosis of inborn errors of amino acid metabolism. As a Staff Research Investigator, he worked at National Center for Nervous, Mental and Muscular Disorders (1980-1982) and Pennsylvania University, Monell Chemical Senses Center (1989-1991). He served as an Associate Professor of Asahi University School of Dentistry (1992-2002) and as a part-time Assistant Professor of Gifu University School of Agriculture (1993-1997), Gifu University School of Medicine (1995-1997) and Ogaki Women's College (1997-2000). He is presently a Professor of Asahi University School of Dentistry. His current research areas include "Pharmacological/toxicological mechanisms of anesthetic agents, phytochemicals and food components".

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