
Preface

Fruits and vegetables contain abundant nutraceuticals or phytochemicals such as carbohydrates, proteins, lipids, vitamins, enzymes, dietary fibers, minerals, antioxidants, flavonoids, and anthocyanins and other diverse components including trace chemicals. Interestingly, the flavonoids and anthocyanins in phytochemicals could be significantly associated with reductions of risk of cardiovascular disease, macular degeneration, and improvements and preventions of many other diseases.

Actually, flavonoids and anthocyanins in plants could play a very important role in our daily health. Our ancestors used them as part of daily life for dyestuffs and folklore medicines. Evidentially, the benefits of colorful flavonoids and anthocyanins have been confirmed by the results of many researchers.

As part of the series *Topics in Heterocyclic chemistry*, this volume titled *Bioactive Heterocycles II* presents comprehensive and up-to-date reviews on selected topics concerning mainly the usefulness for human health of flavonoids and related compounds, *Sophora* flavonoids and their functions in *Sophora* species (*Leguminosae*), the relationship of biological activity with the diverse structures of heterocycles by quantum chemical calculation, advances in bioactive mesoionic heterocycles, and the spectroscopic properties and application of bioactive phenothiazines including also benzo[*a*]phenothiazines.

The first chapter, "Anthocyanins as Functional Food Colors" by Noboru Motohashi and Hiroshi Sakagami, presents the structures of flavonoids and anthocyanins and their functions, especially protective activity against age-related diseases such as hypertension, diabetes, heart defects and others. Anthocyanins have higher antioxidant activity against oxidative stress, and thus the human body might be protected from oxidative injury by anthocyanins. On the basis of these facts, this review presents the biosynthesis of plant flavonoids and their ability to scavenge oxidants, inhibit or activate enzymes, and the safety of proanthocyanidins and anthocyanidins present in daily food intake. This review might be beneficial for understanding the structures and functions of flavonoids and anthocyanins in relation to bioflavonoid nutraceuticals.

The second chapter, "Flavonoids in *Sophora* Species" by Yoshiaki Shirataki and Noboru Motohashi, presents the relationships of diverse *Sophora* flavonoids with their functions in *Sophora* species of *Leguminosae*, which abundantly exist in the natural kingdom. Many *Sophora* flavonoids with *Sophora*

plant phenols exist in a remarkable position. Many flavonoids have been used since ancient times as important natural pigments or dyestuffs and as medicines. These flavonoids are useful for the health of daily human life because some colorful anthocyanins with their glucosides have effects related to color therapy and, nutraceutical and functional values for foodstuffs. This Chapter concentrates on flavonoids in *Sophora* plants, and the relationship of the chemical structures to the benefits of their nutraceuticals. For this purpose, soy-based infant formulas, osteoporosis, antitumor activity, antimicrobial activity, anti-HIV activity, radical generation and O_2^- scavenging activity, and enzyme inhibitory activity have been described. This review will be useful to researchers in the field of effectiveness of *Sophora* nutraceuticals in disease prevention and treatment.

The third chapter, "Quantitative Structure-Cytotoxicity Relationship of Bioactive Heterocycles by the Semi-empirical Molecular Orbital Method with the Concept of Absolute Hardness" by Mariko Ishihara, Hiroshi Sakagami, Masami Kawase, and Noboru Motohashi, presents the relationship between the cytotoxicity (defined as 50% cytotoxic concentration) of heterocycles such as phenoxazine, 5-trifluoromethyloxazoles, *O*-heterocycles such as 3-formylchromone and coumarins, and vitamin K₂ derivatives against some tumor cell lines and 15 chemical descriptors. The results suggest the importance of selecting the most appropriate descriptors for each cell type and compound. The review is of interest as it represents the relationship of the molecular structures with the cytotoxic activity of these heterocycles.

The fourth chapter, "The Chemistry of Bioactive Mesoionic Heterocycles" by Masami Kawase, Hiroshi Sakagami, and Noboru Motohashi, presents the latest developments in the biologically interesting mesoionic compounds, such as sydnones, sydnonimines, 1,2,3,4-oxatriazolium-5-aminates, and 1,3,4-thiadiazolium-2-aminides, mainly since 2000. Most mesoionics are generally unstable and are not stable enough to be assayed for their biological activities in vitro. However, the mesoionics are endowed with charged, yet net neutral electrical character and their chemical properties are valuable assets in their potential usefulness as medicinal agents. Several mesoionic compounds have shown a wide spectrum of biological activity. Especially, their properties as NO-releasing compounds have been extensively investigated and the biomedical mechanism of NO has been elucidated by several mesoionics utilized as a probe. This review could contribute to the development of novel drugs in medicinal chemistry.

The last chapter, "Bioactive Phenothiazines and Benzo[*a*]phenothiazines: Spectroscopic Studies, Biological and Biomedical Properties and Applications" by Jean-Jacques Aaron, Mame Diabou Gaye-Seye, Snezana Trajkovska, and Noboru Motohashi, presents recent advances in the spectroscopic, photophysical, photochemical, and analytical studies of bioactive phenothiazines and benzophenothiazines, including also their biological and biomedical properties, as well as recent results from the authors of this review Chapter. The

electronic absorption and luminescence spectral properties, and the complexation and interactions of these compounds in organized media have been discussed. Moreover, various analytical and biomedical applications, relative to phenothiazines and benzophenothiazines have been described. Among the important biological and biomedical properties of these compounds, their neurological effects, their antibacterial, antifungal, antiviral, antiparasitic and antitumor activities, and their cytotoxicity have been particularly emphasized. This review especially shows the interest in studying the electronic absorption and luminescence spectroscopy of phenothiazines and benzophenothiazines, since some relationships between their spectral properties and their molecular structure as well as their biological activity have been observed.

It is hoped that this volume could lead to advances in the medicinal chemistry of flavonoids and anthocyanins in relation to human health and lead to higher interest among researchers in the field of phytochemical nutraceuticals, especially flavonoids and anthocyanins.

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