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Part 1: Abstract and Introduction

Abstract

Flavonoids, a group of natural substances with variable phenolic structures, are found in fruits, vegetables, grains, bark, roots, stems, flowers, tea and wine. These natural products are well known for their beneficial effects on health and efforts are being made to isolate the ingredients so called flavonoids. Flavonoids are now considered as an indispensable component in a variety of nutraceutical, pharmaceutical, medicinal and cosmetic applications. This is attributed to their anti-oxidative, anti-inflammatory, anti-mutagenic and anti-carcinogenic properties coupled with their capacity to modulate key cellular enzyme function. Research on flavonoids received an added impulse with the discovery of the low cardiovascular mortality rate and also prevention of CHD.

Information on the working mechanisms of flavonoids is still not understood properly. However, it has widely been known for centuries that derivatives of plant origin possess a broad spectrum of biological activity. Current trends of research and development activities on flavonoids relate to isolation, identification, characterisation and functions of flavonoids and finally their applications on health benefits. Molecular docking and knowledge of bioinformatics are also being used to predict potential applications and manufacturing by industry. In the present review, attempts have been made to discuss the current trends of research and development on flavonoids, working mechanisms of flavonoids, flavonoid functions and applications, prediction of flavonoids as potential drugs in preventing chronic diseases and future research directions.

Introduction

Flavonoids are an important class of natural products; particularly, they belong to a class of plant secondary metabolites having a polyphenolic structure, widely found in fruits, vegetables and certain beverages. They have miscellaneous favourable biochemical and antioxidant effects associated with various diseases such as cancer, Alzheimer's disease

(AD), atherosclerosis, etc. Flavonoids are associated with a broad spectrum of health-promoting effects and are an indispensable component in a variety of nutraceutical, pharmaceutical, medicinal and cosmetic applications. This is because of their antioxidative, anti-inflammatory, anti-mutagenic and anti-carcinogenic properties coupled with their capacity to modulate key cellular enzyme functions. They are also known to be potent inhibitors for several enzymes, such as xanthine oxidase (XO), cyclo-oxygenase (COX), lipoxygenase and phosphoinositide 3-kinase.

In nature, flavonoid compounds are products extracted from plants and they are found in several parts of the plant. Flavonoids are used by vegetables for their growth and defence against plaques. They belong to a class of low-molecular-weight phenolic compounds that are widely distributed in the plant kingdom. They constitute one of the most characteristic classes of compounds in higher plants. Many flavonoids are easily recognised as flower pigments in most angiosperm families. However, their occurrence is not restricted to flowers but are found in all parts of plants.

Flavonoids are also abundantly found in foods and beverages of plant origin, such as fruits, vegetables, tea, cocoa and wine; hence they are termed as dietary flavonoids. Flavonoids have several subgroups, which include chalcones, flavones, flavonols and isoflavones. These subgroups have unique major sources. For example, onions and tea are major dietary sources of flavonols and flavones. Flavonoids play a variety of biological activities in plants, animals and bacteria. In plants, flavonoids have long been known to be synthesised in particular sites and are responsible for the colour and aroma of flowers, and in fruits to attract pollinators and consequently fruit dispersion to help in seed and spore germination, and the growth and development of seedlings. Flavonoids protect plants from different biotic and abiotic stresses and act as unique UV filters, function as signal molecules, allelopathic compounds, phytoalexins, detoxifying agents and antimicrobial defensive compounds.

Flavonoids have roles against frost hardiness, drought resistance and may play a functional role in plant heat acclimatisation and freezing tolerance. Jorgensen has mentioned that the

early advances in floral genetics were primarily due to mutation techniques making an impact on flavonoid-derived flower colours, and demonstrated that functional gene silencing in plants was associated with flavonoid biosynthesis. Flavonoids have been attributed positive effects on human and animal health and the current interest is for disease therapy and chemoprevention. Currently there are about 6000 flavonoids that contribute to the colourful pigments of fruits, herbs, vegetables and medicinal plants.

Dixon & Pasinetti reviewed plant flavonoids and isoflavonoids in detail and discussed their applications to agriculture and neurosciences in human beings. Kumar & Pandey reviewed the protective roles of flavonoids against human diseases as well as their functions in plants. Recently Panche et al., while reviewing AD and current therapeutic methods, discussed in detail uses of flavonoids as plant secondary metabolites for the treatment of AD and the mechanisms involved. In the present review, attempts have been made to discuss the current trends of research and development on flavonoids, their applications as dietary and health benefits along with broad classification and future research directions.

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Part 2: Classifications and Sources

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