

*Review Article*

**Chemistry and Health benefits to humans of Some Flavonoids: An Overview**

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**ABSTRACT**

Flavonoids are low molecular weight secondary metabolites that are produced by plants, and described as non-essential for plant survival, primary metabolites. Flavonoids are able to interact with many diverse targets in sub cellular locations to elicit various activities in microbes, plants and animals. Flavonoids are abundant in plants, in which they perform several functions. The rhizobia present in soil produce Nod factors in response to the presence of flavonoids. Flavonoid” is used to describe a broad collection of natural products that include a C<sub>6</sub>-C<sub>3</sub>-C<sub>6</sub> carbon framework, specifically phenyl benzopyran functionality. Depending on the position of the linkage of the aromatic ring to the benzopyrano (chromano) moiety, Flavonoids are important antioxidants, and promote several health effects.

**KEYWORDS**

Flavonoids, Nod factor, Classification, Natural sources, Health benefit to humans.

## 1. INTRODUCTION

Flavonoids are low molecular weight secondary metabolites that are produced by plants, and described as non-essential for plant survival, primary metabolites. Due to their physical and biochemical properties, flavonoids also are able to interact with many diverse targets in subcellular locations to elicit various activities in microbes, plants and animals. Foods high in flavonoids are Apples, Blueberries, Broccoli, Cabbage, Capers, Chocolate and cocoa, Onions, Strawberries. Flavonoids are abundant in plants, in which they perform several functions. They are essential pigments for producing the colors needed to attract pollinating insects. In higher order plants, flavonoids are also required for UV filtration, nitrogen fixation, cell cycle inhibition, and as chemical messengers. Flavonoids secreted by a plant's roots aid the symbiotic relationship between rhizobia and certain vegetables such as peas, clover and beans. The rhizobia present in soil produce Nod factors in response to the presence of flavonoids. Nodulation in legumes evolved as a highly specific interaction between the legumes and gram-negative soil bacteria called rhizobia. These Nod factors are then recognized by the plant, which induces certain responses such as ion fluxes and root nodule formation. Some flavonoids also inhibit certain spores to protect against certain plant diseases. Flavonoids are ubiquitous in plants and are the most common type of polyphenolic compound found in the human diet.

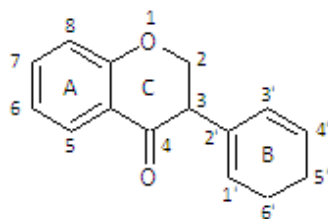
### *1.1. Chemistry of Flavonoids*

The term "flavonoid" is generally used to describe a broad collection of natural products that include a C<sub>6</sub>-C<sub>3</sub>-C<sub>6</sub> carbon framework, or more specifically phenyl benzopyran functionality. Depending on the position of the linkage of the aromatic ring to the benzopyrano (chromano) moiety, this group of natural products may be divided into three classes:

1. Isoflavonoids (3-benzopyrans)
2. Neoflavonoids (4-benzopyrans)
3. Chalcone precursor, are biogenetically and structurally related.

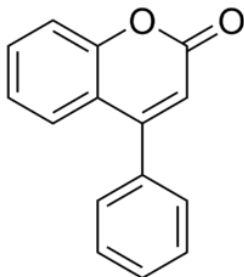
Based on the degree of oxidation and saturation present in the heterocyclic C-ring, the flavonoids may be divided into the following groups:

### *1. Isoflavonoids*



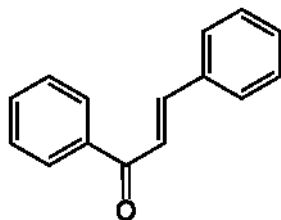
These compounds possess a 3-phenylchroman skeleton that is biogenetically derived by 1, 2-aryl migration in a 2-phenylchroman precursor. They are remarkably diverse as far as structural variations are concerned. This arises not only from the number and complexity of substituents on the basic 3-phenylchroman system, but also from the different oxidation levels and presence of additional heterocyclic rings.

## 2. Neoflavonoids



The neoflavonoids are structurally related to the flavonoids and the isoflavonoids and comprise the 4-aryl coumarins (4-aryl-2H-1-benzopyran-2-ones), 3, 4-dihydro-4-aryl coumarins, and neoflavones.

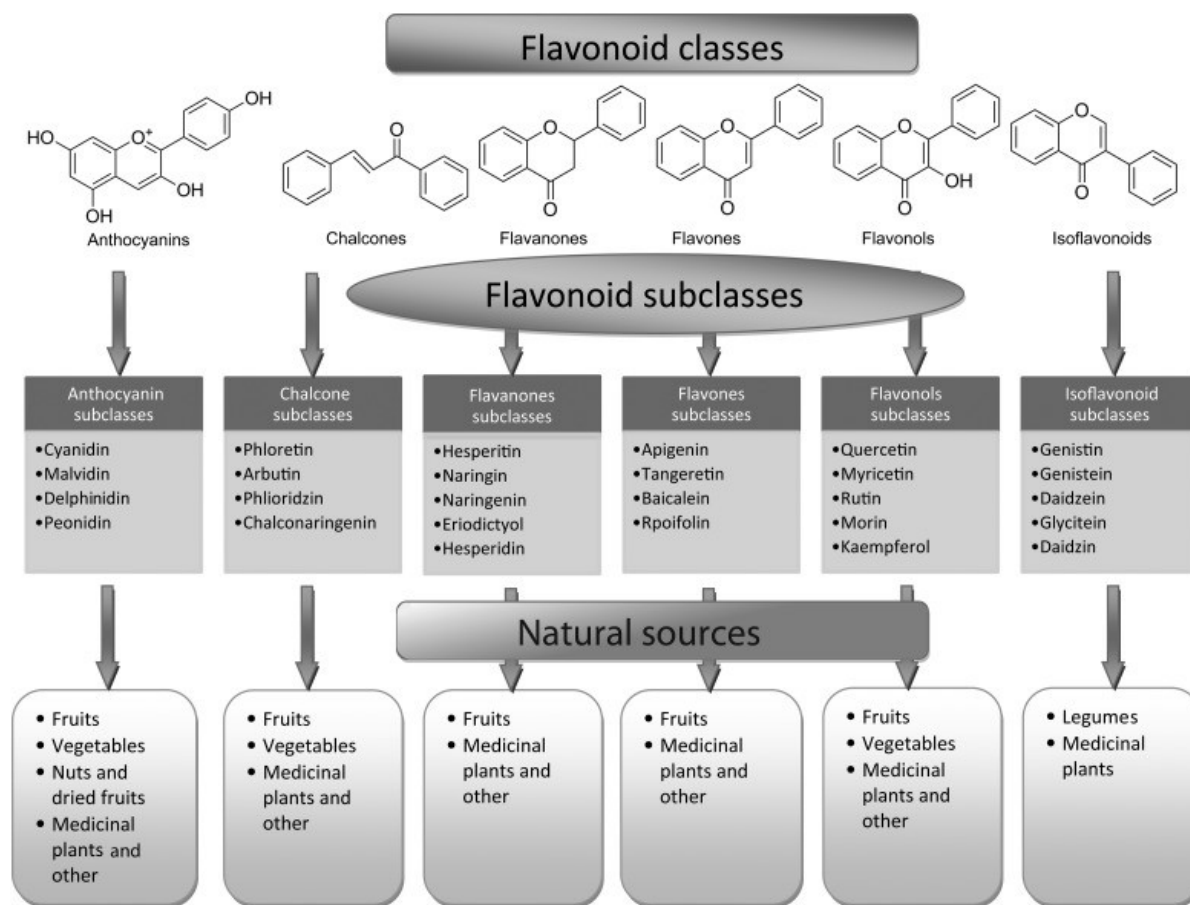
## 3. Chalcone precursor



Chalcones, considered to be the precursor of flavonoids and isoflavonoids, are abundant in edible plants. They consist of open-chain flavonoids in which the two aromatic rings are joined by a three-carbon  $\alpha$ ,  $\beta$ -unsaturated carbonyl system. Studies revealed that compounds with a Chalcone-based structure have anti-inflammatory, anti-bacterial, antifungal and anti-tumor activities. These activities are attributed due to  $\alpha$ ,  $\beta$ -unsaturated ketone moiety. Chalcones are  $\alpha$ -unsaturated ketone containing the reactive ketoethylenic group – CO-CH=CH-. These are colored compounds because of the presence of the chromophore -CO-CH=CH-, which depends in the presence of other auxochromes.

### 1.2. Minor Flavonoids

Natural products such as chalcones and aurones also contain a C<sub>6</sub>-C<sub>3</sub>-C<sub>6</sub> backbone and are considered to be minor flavonoids. These groups of compounds include the 2'-hydroxychalcones, 2'-OH-dihydrochalcones, 2'-OH-retro-chalcone, aurones (2-benzylidenecoumaranone), and auronols.



### 1.3. Health benefits to humans

Flavonoids are important antioxidants, and promote several health effects. Aside from antioxidant activity, these molecules provide the following beneficial effects:

- Anti-viral
- Anti-cancer
- Anti-inflammatory
- Anti-allergic

### 1.4. Antiviral effects

The antiviral activity of flavonoids was shown in a study by Wang et al (80). Some of the viruses reported to be affected by flavonoids are herpes simplex virus, respiratory syncytial virus, parainfluenza virus, and adenovirus. Quercetin was reported to exhibit both antiinfective and antireplicative abilities.

### 1.5. Antitumor effects

The antitumor activity of flavonoids is a point of discussion. Antioxidant systems are frequently inadequate, and damage from reactive oxygen species is proposed to be involved in carcinogenesis. Reactive oxygen species can damage DNA, and division of cells with unrepaired or misrepaired damage leads to mutations. Flavonoids, such as fisetin, apigenin, and luteolin are

potent inhibitors of cell proliferation. A clinical study suggested that the presence of an inverse association between flavonoid intake and the subsequent incidence of lung cancer. This effect was mainly ascribed to quercetin, which provided >95% of the total flavonoid intake in that particular study.

#### *1.6. Anti-inflammatory effect*

Acute inflammation is short-term, self-limiting and it's easy for host defenses to return the body to homeostasis. Chronic inflammatory responses are predispose to a pathological progression of chronic illnesses. Inflammation is a normal biological process in response to tissue injury, microbial pathogen infection and chemical irritation. Biological process involves innate and adaptive immune systems. At a damaged site, inflammation is initiated by migration of immune cells from blood vessels and release of mediators, followed by recruitment of inflammatory cells and release of Reactive Oxygen Species (ROS), Reactive Nitrogen Species (RNS) and pro inflammatory cytokines to eliminate foreign pathogens, resolving infection and repairing injured tissues .characterized by infiltration of inflammatory cells.

Chronic inflammation can inflict more serious damage to a host tissue than bacterial infection. Diverse ROS and RNS such as  $\bullet\text{O}_2^-$  (superoxide anion),  $\bullet\text{OH}$  (hydroxyl radical),  $\text{H}_2\text{O}_2$  (hydrogen peroxide), nitric oxide (NO), and  $^1\text{O}_2$  (singlet oxygen) generated by inflammatory cells injure cellular biomolecules including nucleic acids, proteins and lipids, causing cellular and tissue damage, which in turn augments the state of inflammation. Inflammatory chemicals produced by inflamed and immune cells also attack normal tissues surrounding the infected tissue, causing oxidative damage and extensive tissue inflammation.

#### *1.7. Anti-allergic effects*

Quercetin is a flavonol that is found in a considerable quantity in various vegetables such as onions and shallots that are affordable throughout the year. Onions are the main sources of dietary quercetin. Onions are thus qualitatively and quantitatively the most important source of quercetin. Other vegetables, including broccoli, asparagus, green peppers, tomatoes etc.. Fruits (apples as well as berry crops, such as strawberry, red raspberry, blueberry, cranberry and black currants), green tea and wine could also be considered abundant dietary.

## **2. CONCLUSIONS**

Allergic disorders (skin, food and respiratory allergies) have been rapidly increasing worldwide during the last three decades. There is a demand for o anti-allergic bioactive compounds. Now days, flavonoids, especially quercetin displays high antioxidant and anti-inflammatory properties that have been proven by many in vivo and in vitro studies.

## **3. ACKNOWLEDGMENTS**

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