

Tuscany Diet



POLYPHENOLS

FLAVONOIDS: DEFINITION, STRUCTURE AND CLASSIFICATION

22 JANUARY 2014 | DR. NICOLA TAZZINI | 17 COMMENTS

[Start Download - View PDF](#)

[Start Download - View PDF](#)

Convert From Doc to PDF, PDF to Doc Simply
With The Free Online App!
[download from doc to pdf.com](#)
Merge & Convert Files into PDFs w/
EasyPDFCombine - Free!
[easypdfcombine.com](#)

Flavonoids: contents in brief

- [What are flavonoids?](#)
- [Chemical structure of flavonoids](#)
- [Classification of flavonoids](#)
- [References](#)

What are flavonoids?

Flavonoids are the most abundant [polyphenols](#) in human diet, representing about 2/3 of all those ones ingested. Like other phytochemicals, they are the products of secondary metabolism of plants and, currently, it is not possible to determine precisely their number, even if over 4000 have been identified.

In fruits and vegetables, they are usually found in the form of glycosides and sometimes as acylglycosides, while acylated, methylated and sulfate molecules are less frequent and in lower concentrations.

They are water-soluble and accumulate in cell vacuoles.

[↑ Back to the top ↑](#)

Chemical structure of flavonoids

Their basic structure is a skeleton of **diphenylpropane**, namely, two benzene rings (ring A and B, see figure) linked by a three carbon chain that forms a closed pyran ring (heterocyclic ring containing oxygen, the C ring) with benzenic A ring. Therefore, their structure is also referred to as C6-C3-C6.

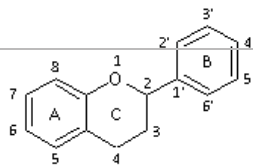


Fig. 1 – Skeleton of
Diphenylpropane

In most cases, B ring is attached to position 2 of C ring, but it can also bind in position 3 or 4; this, together with the structural features of the ring B and the patterns of glycosylation and hydroxylation of the three rings, makes the flavonoids one of the larger and more diversified groups of phytochemicals, so not only of **polyphenols**, in nature.

Their biological activities, for example they are potent antioxidants, depend both on the structural characteristics and the pattern of glycosylation.

↑ [Back to the top](#) ↑

Classification of flavonoids

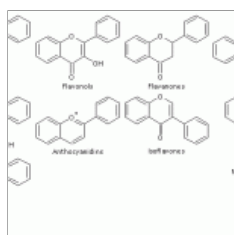


Fig. 2 – **Flavonoid** Subgroups

They can be subdivided into different subgroups depending on the carbon of the C ring on which B ring is attached, and the degree of unsaturation and oxidation of the C ring.

Flavonoids in which B ring is linked in position 3 of the ring C are called **isoflavones**; those in which B ring is linked in position 4, **neoflavonoids**, while those in which the B ring is linked in position 2 can be further subdivided into several subgroups on the basis of the structural features of the C ring. These subgroup are: **flavones**, **flavonols**, **flavanones**, **flavanonols**, **flavanols or catechins** and **anthocyanins**.

Finally, flavonoids with open C ring are called chalcones.

[Start Download - View PDF](#)

[Start Download - View PDF](#)

Convert From Doc to PDF, PDF to Doc Simply
With The Free Online App!
[download from doc to pdf](#)
Merge & Convert Files into PDFs w/
EasyPDFCombine - Free!
[easypdfcombine.com](#)

- **Flavones**

They have a double bond between positions 2 and 3 and a ketone in position 4 of the C ring. Most flavones of vegetables and fruits has a hydroxyl group in position 5 of the A ring, while the hydroxylation in other positions, for the most part in position 7 of the A ring or 3' and 4' of the B ring may vary according to the taxonomic classification of the particular vegetable or fruit.

Glycosylation occurs primarily on position 5 and 7, methylation and acylation on the hydroxyl groups of the B ring.

Some flavones, such as nobiletin and tangeretin, are polymethoxylated.

- **Flavonols**

Compared to flavones, they have a hydroxyl group in position 3 of the C ring, which may also be glycosylated. Again, like flavones, **flavonols** are very diverse in methylation and hydroxylation patterns as well, and, considering the different glycosylation patterns, they are perhaps the most common and largest subgroup of flavonoids in fruits and vegetables. For example, quercetin is present in many plant foods.

- **Flavanones**

Flavanones, also called dihydroflavones, have the C ring saturated; therefore, unlike flavones, the double bond between positions 2 and 3 is saturated and this is the only structural difference between the two subgroups of flavonoids.

The flavanones can be multi-hydroxylated, and several hydroxyl groups can be glycosylated and/or methylated.

Some have unique patterns of substitution, for example, furanoflavanones, prenylated flavanones, pyranoflavanones or benzylated flavanones, giving a great number of substituted derivatives.

Over the past 15 years, the number of flavanones discovered is significantly increased.

- **Flavanonols**

Flavanonols, also called dihydroflavonols, are the 3-hydroxy derivatives of flavanones; they are an highly diversified and multisubstituted subgroup.

- **Isoflavones**

As anticipated, **isoflavones** are a subgroup of flavonoids in which the B ring is attached to position 3 of the C ring. They have structural similarities to estrogens, such as estradiol, and for this reason they are also called phytoestrogens. **Neoflavonoids**

They have the B ring attached to position 4 of the C ring.

- **Flavanols or flavan-3-ols or catechins**

Flavanols are also referred to flavan-3-ols as the hydroxyl group is almost always bound to position 3 of C ring; they are called **catechins** as well.

flavanols to have two chiral centers in the molecule, on positions 2 and 3, then four possible diastereoisomers. Epicatechin is the

isomer with the *cis* configuration and catechin is the one with the *trans* configuration. Each of these configurations has two stereoisomers, namely, (+)-epicatechin and (-)-epicatechin, (+)-catechin and (-)-catechin.

(+)-Catechin and (-)-epicatechin are the two isomers most often present in edible plants.

Another important feature of **flavanols**, particularly of catechin and epicatechin, is the ability to form polymers, called **proanthocyanidins or condensed tannins**. The name "proanthocyanidins" is due to the fact that an acid-catalyzed cleavage produces **anthocyanidins**.

Proanthocyanidins typically contain 2 to 60 monomers of flavanols.

Monomeric and oligomeric **flavanols** (containing 2 to 7 monomers) are strong antioxidants.

- **Anthocyanidins**

Chemically, **anthocyanidins** are flavylium cations and are generally present as chloride salts.

They are the only group of flavonoids that gives plants colors (all other flavonoids are colorless).

Anthocyanins are glycosides of **anthocyanidins**. Sugar units are bound mostly to position 3 of the C ring and they are often conjugated with phenolic acids, such as ferulic acid.

The color of the **anthocyanins** depends on the pH and also by methylation or acylation at the hydroxyl groups on the A and B rings.

- **Chalcones**

Chalcones and dihydrochalcones are flavonoids with open structure; they are classified as flavonoids because they have similar synthetic pathways.

[↑ Back to the top ↑](#)

References

de la Rosa L.A., Alvarez-Parrilla E., González-Aguilar G.A. Fruit and vegetable phytochemicals: chemistry, nutritional value, and stability. 1th Edition. Wiley J. & Sons, Inc., Publication, 2010

Han X., Shen T. and Lou H. Dietary polyphenols and their biological significance. Int J Mol Sci 2007;9:950-988. doi:[10.3390/i8090950](#)

Manach C., Scalbert A., Morand C., Rémésy C., and Jime´nez L. Polyphenols: food sources and bioavailability. Am J Clin Nutr 2004;79(5):727-47 [[Abstract](#)]

Tsao R. Chemistry and biochemistry of dietary polyphenols. Nutrients 2010;2:1231-1246. doi:[10.3390/nu2121231](#)



17 THOUGHTS ON “FLAVONOIDS: DEFINITION, STRUCTURE AND CLASSIFICATION”

 **Razi Ali Alalqam**

19 FEBRUARY 2015 AT 11:46

how can I see the reaction of flavonoids with hydrogen peroxidase (H₂O₂).

 ★ **Dr. Nicola Tazzini**

21 FEBRUARY 2015 AT 11:04

“Peroxidase (POD) catalyzes oxidation of a wide range of o-diphenolic substrates to o-quinones, using hydrogen peroxide as a co-substrate (3):

o-Diphenol + H₂O₂ → o-quinone + 2H₂O (3)

This activity is present in grape but has never been reported in musts....”

From: Flavonoids. Chemistry, Biochemistry

and Applications. Edited by Øyvind M. Andersen, Kenneth R. Markham. 2006, Taylor & Francis Grupo, pag 287.

 **ayela gul**

28 NOVEMBER 2015 AT 07:33

i want to remove chlorophyll from leaves of hibiscus rosa sinensis along with extraction of flavonoids. how i should use chemical for removal of chlorophyll which has not effect on favonoids?

 ★ **Dr. Nicola Tazzini**

13 FEBRUARY 2016 AT 15:17

Sorry, but this is outside of my area of expertise.

 **subodh gangurde**

10 MAY 2016 AT 08:27

extraction of flavonids can be done by methanol and concentrate the methanol extract and extract with ethyl acetate...

 **Dr. James A. Durante**

13 APRIL 2016 AT 20:54

why do flavonoids found in diet sodas have the biochemical effect of stabilizing the weight of the person, and inhibiting weight loss?

 ★ **Dr. Nicola Tazzini**

16 APRIL 2016 AT 07:47

Sorry, but there are no articles on Pub.Med.gov which support your thesis.

 **subodh gangurde**

10 MAY 2016 AT 08:28

hey i can help you for doing so...extraction

 **Navruzбек**

25 APRIL 2017 AT 02:38

How do you think about extraction of rutin with water.

 ★ **Dr. Nicola Tazzini**

25 APRIL 2017 AT 10:27

Dear Habibullayev,

i'm sorry but this is outside of my knowledge.

However, you can find many information about extraction of rutin on:

<http://www.sciencedirect.com/science/article/pii/S0378874113007435>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4189274/>

<https://pubchem.ncbi.nlm.nih.gov/compound/5280805#section=Physical-Description>

<http://www.hmdb.ca/metabolites/HMDB03249>

 **Charles E Holland**

1 OCTOBER 2016 AT 17:42

which of the flavonoid is good for diabetics to help with blood sugar

 ★ **Dr. Nicola Tazzini**

4 OCTOBER 2016 AT 14:49

There are many flavonoids which, in animal and in vitro studies, were found to be useful in diabetes treatment. Some example are diosmin, fisetin, morin, hesperidin, naringenin, apigenin, luteolin, isorhamnetin, kaempferol, quercetin, cyanidin, and genistein. For further details you may refer to PubMed.

 **deviika**

3 MARCH 2017 AT 05:23

how can i see various chemical reactions of flavonoid nucleus ?

 ★ **Dr. Nicola Tazzini**

4 MARCH 2017 AT 15:05

You may find some information about chemical reactions of flavonoid nucleus in:

Andersen Ø.M., Markham K.R. Flavonoids: chemistry, biochemistry, and applications. CRC Press Taylor & Francis Group, 2006, chapter 5, pag 289

de la Rosa L.A., Alvarez-Parrilla E., González-Aguilar G.A. Fruit and vegetable phytochemicals: chemistry, nutritional value, and stability. 1th Edition. Wiley J. & Sons, Inc., Publication, 2010, chapter 5.

 **deviika**

14 MARCH 2017 AT 06:49

Thank you 😊

 **Mannu**

16 NOVEMBER 2017 AT 09:12

which extraction method will be best for extraction of flavonoids in the plant material?

 ★ **Dr. Nicola Tazzini**

13 DECEMBER 2017 AT 08:34

You can find information on flavonoid extraction from plant material in “Andersen Ø.M., Markham K.R. Flavonoids: chemistry, biochemistry, and applications. CRC Press Taylor & Francis Group, 2006”, chapter 1 (Separation and quantification of flavonoids).