* + Flavonoidal compounds are considered as the largest group of naturally occurring phenols.
  + Flavonoidals constitute the majority of the yellow colored plant pigments.
  + Many flavonoidal compounds present as a glycosidic or as a free forms.
  + All derived from the same parent nucleus, 2-phenyl-benzopyran (flavan), thus they have a basic C-15 skeleton.

Flavonoidal compounds are classified according to the **oxidation level** of central pyran ring they are classified into **flavones**, **isoflavones, flavonols**, **flavanones**, (true flavanoids) **anthocyanidins**, **chalcones** and **aurones**.

True flavones, are **2-phenyl chromones** (2-phenyl benzopyrone), while isoflavones are **3-phenyl chromones** der.

Flavonols are **3-hydroxyflavones**, while flavanones are 2**,3-dihydro** der. of flavones (**2,3-double bond is lacking**).

**(2-phenylbenzopyran) (2-phenylbenzopyrone)**



**Anthocyanidines,** chalcones and aurones are lack the typical flavone structure. Anthocyanidins and its glycosides (anthecyanins) are ionic oxonium salts. This is responsible for the permanent blue, purple, violet, mauve, and red color of flower, fruits and leaves of higher plants.

Anthocyanidins and anthecyanins are soluble in polar solvents.

**Cyanidin chloride** is an example of anthocyanidines .



**Chalcones,** have **no** central pyrone ring, so they are not **true flavonoidal** compounds. The parent compound chalcone, is chemically phenyl-styryl ketone, or benzylidene acetophenone.

**Aurones** are oxidized forms that are obtained by enzymatic oxidation. Instead of the central **pyrone ring** of the normal flavonoidal structure, **aurones** have **five membered ring**.

**Chalcon Aurone**

**Flavonoids** dissolve in alkalis give intense yellow color solution, on the addition of acid become colorless.

**Flavonoids** exhibit strong fluorescence under UV light.

**Flavonoidal glycosides** are soluble in water and alcohol. Ethyl acetate is the solvent of choice for the extraction of flavonoids from aqueous solution.

**Flavonoids** compounds may be characterized through the **investigation of their UV Spectra**, that usually show **two main bands**,

1- **Band at higher wavelength (band I)** which is attributed to the **cinnamoyl** fraction of the flavonoidal structure **Why?**.

2- **Band at lower wavelength** **(band II)** which is due to the **benzoyl** fraction of the flavonoidal structure.



**Band I >> 300 nm**

If R= H R=OH R=O-substitution

Flavones flavonols 3-sub flavonol

**Band I: 304-350 nm Band I: 352-385 Band I: 328-357**

**Band II << 300nm**

**(250-280 nm)**

Note:

**More OH in ring A:** Bathochromic shift in band II.

**More OH in ring B:** Bathochromic shift in band I.

**Shift reagents:**

Back to lab.

**1- Diosmin: flavone glycoside**

**Occurance:** buchu leaves, *Barosma crenulata* F. Rutaceae.

**Uses:** diuretic and diaphoretic action of the leaves is owed in part to diosmin, and in part to diosphenol, the main constituent of the volatile oil of the leaf.



**Diosmin**

Upon hydrolysis, diosmin yields rhamnose, glucose and **diosmetin.**

**2- Rutin and quercetrin: are examples of flavonol glycosides**

**a- Rutin** occurs in the leaves of buckwheat. It is the 3-rhamnoglucoside **(called rutinose)** of the genin quercitin.

It gives on hydrolysis the aglycone **(quercitin)** beside one molecule of glucose, and one molecule of rhamnose.

Rutin is used to

1- Decrease capillary fragility.

2- It is a biflavonoids that plays a true vitamin function.

**b- Quercitrin** is quercitin 3-O-rhamnoside.

It occurs in the bark of *Quercus tinctoria*.

**Quercitrin** yield upon acid hydrolysis rhamnose and quercetin.

**The aglycone quercetin** occurs in bearberry leaves (Uva Ursi) and has a diuretic action of the leaves.



**3- Hesperidin:** it is an example of flavanones. It is the main flavonoidal glycoside of citrus fruits.



Upon hydrolysis by acid, **hesperidin** gives rhamnose, glucose and hesperitin.

**Uses:**

1- Hesperidin appears to be identical to vitamin P (citrin).

2- It is necessary for absorption and retention of vit C that lead to decrease capillary fragility.

3- Decrease CVD and HTN.

**Uses of flavonoids:**

1. Increase capillary resistance and decrease vitamins C & P deficiency.
2. They are recommended in the treatment of thrombopenia (blood coagulation).
3. They are reported of value in the treatment of influenza, when given with ascorbic acid.

**Isoflavone:**

1. Genistein show significant oestrogenic activity.



1. **R**otenoids employed as insecticide.



**Flavono-lignans**

Coupling of a flavonoid moiety with hemi-lignan molecule by oxidative coupling.



The leaves and fruits of *Silybum marianum* family Compositae contain silymarin (silybin).



1- Silymarin is a very effective lipotropic and hepato protective therapy.

2- It is a free radical scavenger.

3- Supportive treatment of acute and chronic alcoholic poisoning and toxin induce hepatitis.

4- It is used for treatment of liver cirrhosis caused by plant toxins (mushroom, amanita), silymarin is applied as intravenous injection.

5- Silymarin is available in the market in the form of tablets, effervescent granules. Trade name legalon, silyhexal, silirex…etc.

**Synthetic flavonoids**

**Flavoxate:**



**Uses:**

To remove pain (anti-spasmodic) and anti-inflammatory of the genitor urinary tract.

Flavoxate tablets are available under several names: Urispas, Uronid, Spasurit, Genurin).