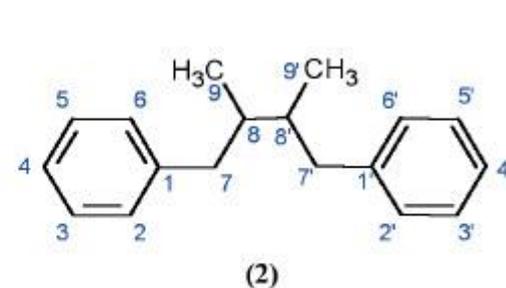
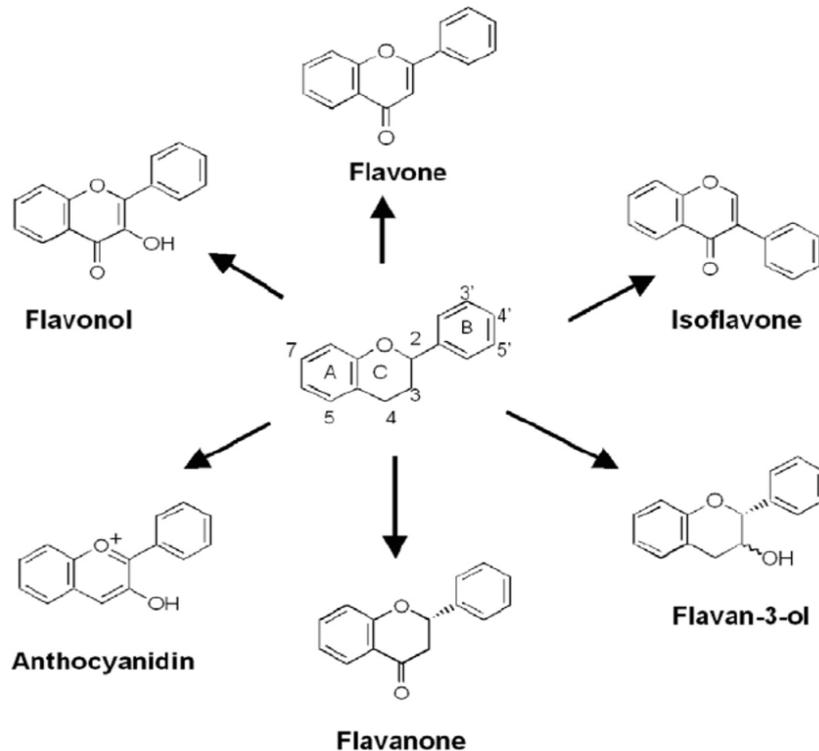


PHENOLICS (INCLUDING FLAVONODS)

~ 8000 different phenolic compounds are being produced by plants and nearly 4500 of them are flavonoids. Flavonoids that are present in red wine, grape, blueberry and other fruits are phenolic compounds which have health benefits. Lignan, another phenolic compound is found abundantly in green vegetables and grains like rye.

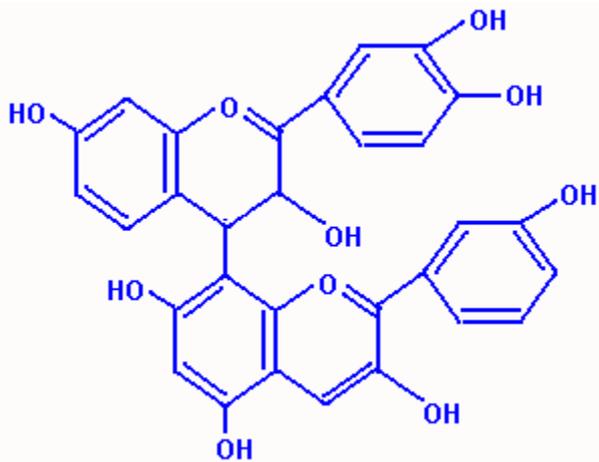


Lignan

- Similar to terpenes, phenolics also have a main subunit that can combine in varying numbers to yield new and different derivatives. This structure of phenolics give them the ability to absorb ultraviolet radiation of the sun and protects them from genetic damage.
- Some phenolics give bitter taste to certain parts of a plant and repel herbivores and others prevent infections due to their antimicrobial properties.

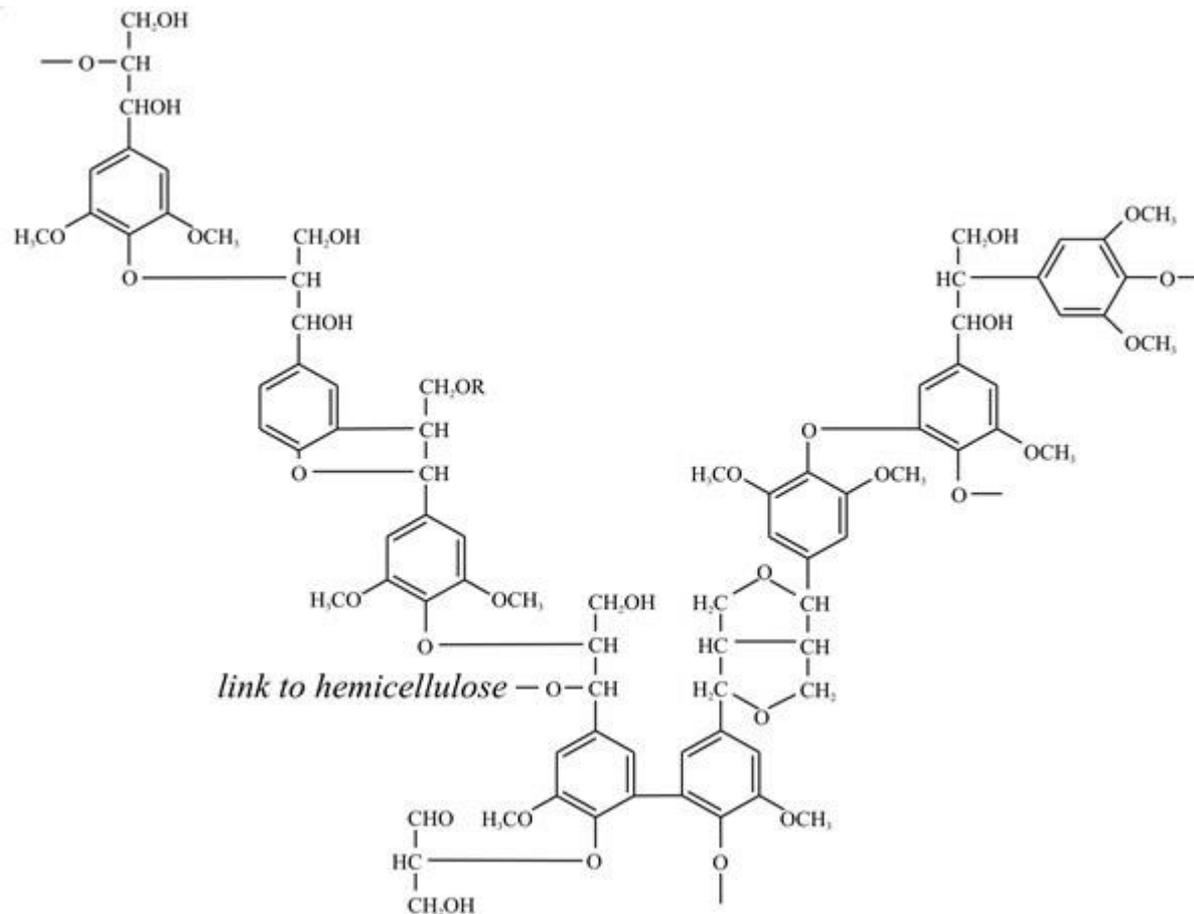
Protective phenolics found in celery, wild carrot, fig and parsley result in the death of insects when they are exposed to light after feeding on these plants. These compounds may also lead to itchiness and rash on the skin when humans contact them.

- **Tannins**: These compounds have toxic effect on most animals and halt microbial growth. They bind to proteins and precipitate them (and also various organic compounds such as amino acids and alkaloids). They contract bacteria and fungi by interfering with their surface proteins. They are mostly found in leaves and also in unripe fruits to prevent them being eaten prematurely.
- Humans have been using plant originated tannins for tannery in leather industry for a long time. The acrid (astringent) taste of tea and red wine is also due to tannins.



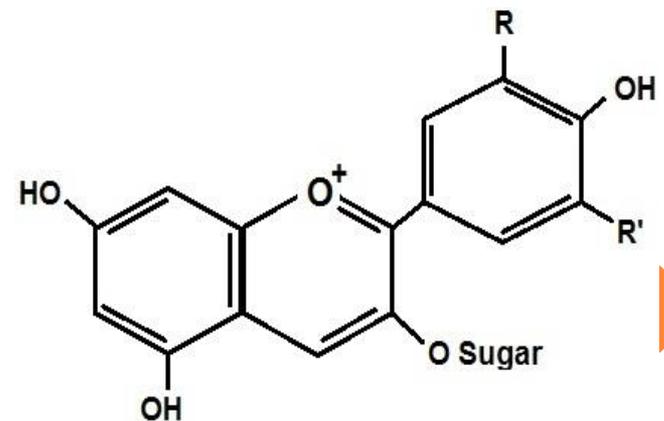
- They are water soluble and due this property are easily extracted from the plants. They have high molecular weight and commonly used against diarrhea.

- **Lignins**: These compounds provide resistance in microbial attacks. It is found to be tasteless for many animal species, therefore it is not consumed. It also provides structural support.



○ **Anthocyanins**: These are the pigments that are found among flavonoids and are known with their beautiful and different colors. Their functions are:

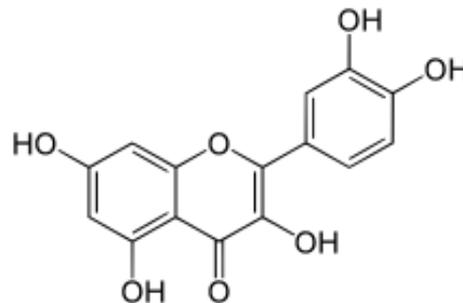
- they attract pollinators and seed dispersers.
- they repel predators, protect cells from damage by excess light
- improve plant tolerance to stress such as drought, UV light
- improve night vision and other vision
- they protect against heart disease.



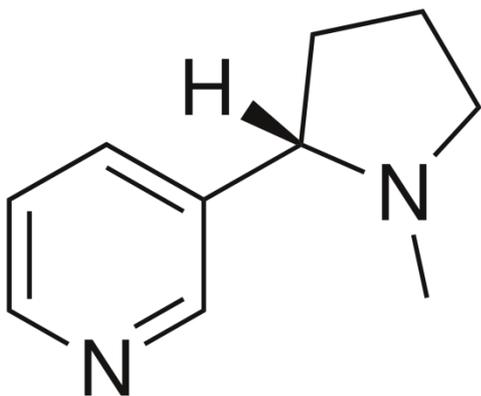
Anthocyanin

Orange, pink or red colors that most flowers and fruits have are due to flavonoid pigments called pelargonidin (from *Pelargonium* sp.). Cyanidins give purple and red colors; delphinidins (comes from *Delphinium* sp.) give pink and blue colors.

- Quercetine, another flavonoid is found in onion and garlic, and has antioxidant and antihistaminic effect

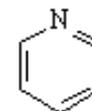
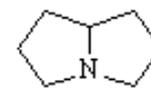
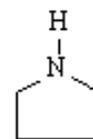
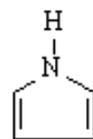
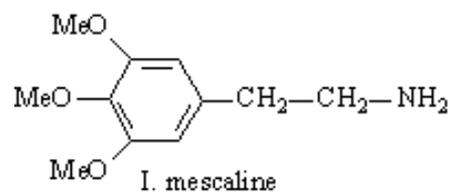


- **Alkaloids**: Some alkaloids, for example nicotine (in tobacco) and caffeine (in coffee and tea) are well known. Alkaloids are used commonly in medicine and drug industry and are very important due to their defensive roles.

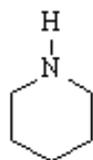


- There are more than 12.000 types of alkaloids and some plants produce more than one type of alkaloids. For example, *Catharanthus roseus* produce more than 100 different types of alkaloids.

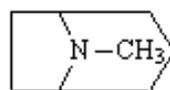
- All alkaloids contain nitrogen in their chemical structures and therefore they are different than other secondary metabolites.



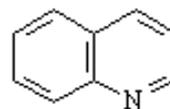
II.1. pyrrole II.2. pyrrolidine II.3. pyrrolizidine II.4. pyridine



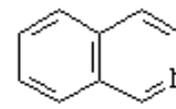
II.5. piperidine



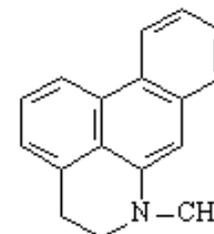
II.6. tropane



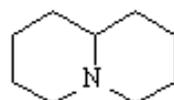
II.7. quinoline



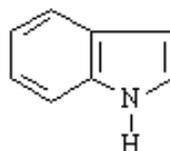
II.8. isoquinoline



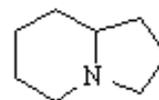
II.9. aporphine



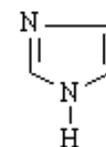
II.10. nor-lupinane



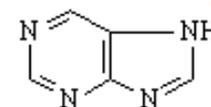
II.11. indole



II.12. indolizidine



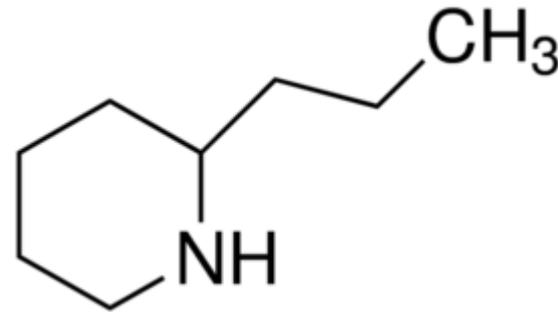
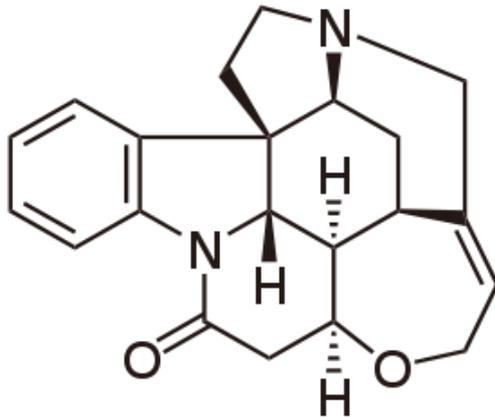
II.13. imidazole



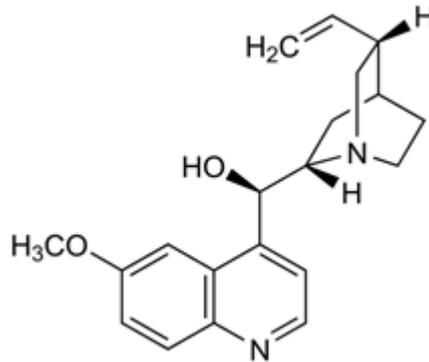
II.14. purine

- Alkaloids are very effective in protecting plants from hungry animals. If they are consumed in high doses then they can have toxic effect.
- Some stimulate the nervous system of animals and yield psychoactive effects. Caffeine found in coffee and tea, theobromine found in chocolate and nicotine found in tobacco stimulates nervous system of humans if taken in small amounts.

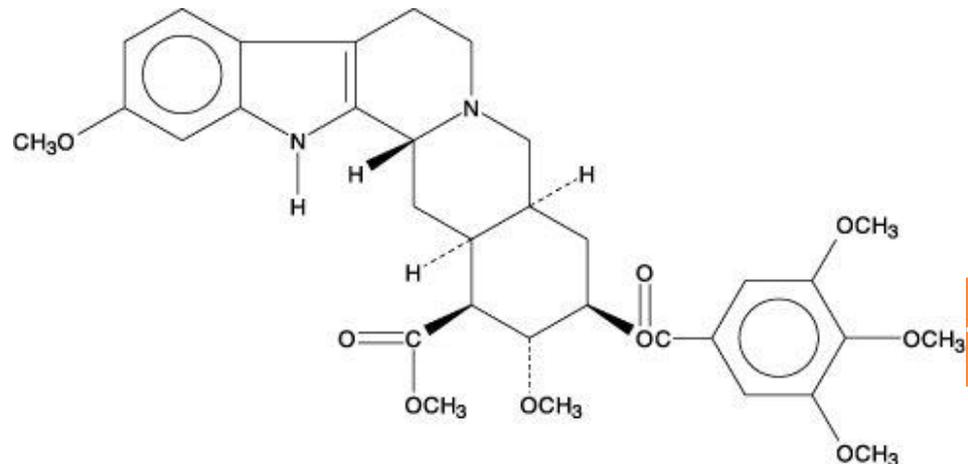
- Strychnine and coniine kill people even in small amounts. Due to this toxic property, extract obtained from *Conium maculatum* had been used in executions.



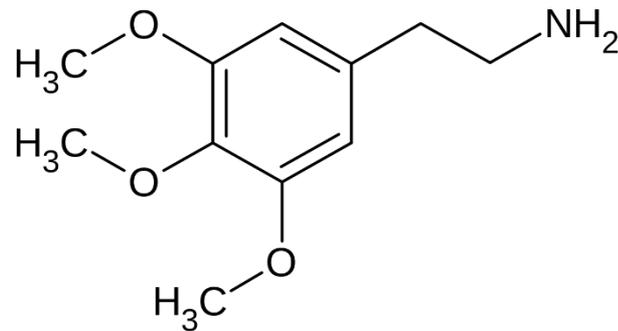
- Chinine obtained from *Cinchona* sp. is used against malaria.



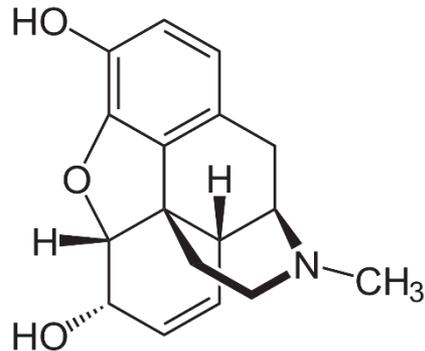
- Reserpine from *Rauwolfia serpentina* has sedative effects and used commonly in the treatment of hypertension.



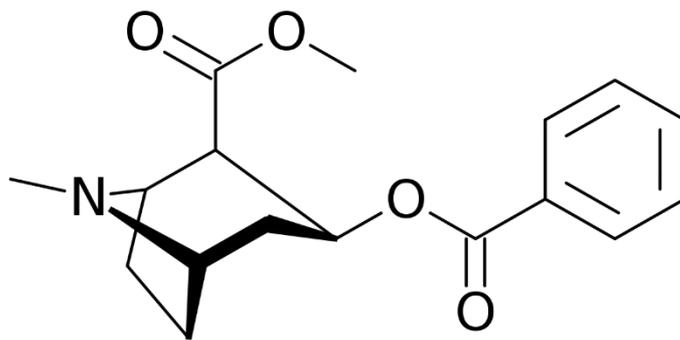
- Some alkaloids have psychoactive effects that lead to hallucinations. *Lophophora williamsii* produces more than 25 alkaloids and used by some Indian tribes in religious rituals. This cactus does not have needles and therefore protects itself with chemical substances. If herbivores eat a piece of this plant, then it may reduce their ability to run away from their own predators and they can be prey.



- Morphine and cocaine are harmful alkaloids that lead to addiction. These are used in pharmaceutical industry and purchased under legal supervision. Morphine is obtained from the latex that is obtained by scratching unripe poppy capsules (fruits). This latex contains 25 other alkaloids that have medicinal uses. For example, codeine is found in the composition of cough medicines.



- Cocaine is obtained from the leaves of *Erythroxylon coca*. It also contains 13 other secondary compounds. It was observed that coca leaves were used by workers to suppress hunger, reduce pain and increase stamina. However these workers did not become addicted to the plant just like cocaine users and do not suffer from its harmful effects.



After repeated and prolonged use, cocaine causes a loss of blood supply to the septum, which is the thin dividing wall between your nostrils. This becomes damaged, causing an erosion of the septum that can leave a gaping hole between the two nose passages." When perforated septum weakens, the bridge of the nose can collapse, leaving behind an unpleasant "smushed-in" look.