The Color of Chemistry: The Photochemistry of Anthocyanins and Metal Porphyrins

Siying Dai (思颖) and Andrew Wein

Abstract

Anthocyanins are water-soluble pigments. The attachment of sugar to anthocyanins makes them particularly soluble in the sap of vacuoles where these molecules are stored, once they are launched. Anthocyanins are responsible for the pink-red colors of most flower petals and red fruits. They absorb light in the blue-green wavelengths, allowing the red wavelengths to be scattered by the plant tissues to make the organs visible to us as red. 50-90% of the naturally occurring anthocyanins are based on six structures. The figure below shows that representative natural anthocyanins include Petunidin, Cyanidin, Peonidin, Delphinidin, Malvidin, and Malteolin. The color of anthocyanins differs with the number of hydroxyl (OH) groups, attached especially those substituted in ring 3. With the increase of attached hydroxyl groups, the visible color of anthocyanin shifts from orange to yellow.

Metal Porphyrins are separated based on central metal ion oxidation with transitions to the lowest unoccupied molecular orbital (LUMO) and HUMO. The electron jumps of these orbitals explain porphyrin color. Normal porphyrin absorption spectra consists of a strong absorption around 400 nm and a weaker one around 550 nm.

The series of alternating single and double bonds on the outside of the ring indicates the presence of the conjugated system as well as the overall planar conformation. In addition to the conjugated system on the outside of the ring, the presence of the nitrogen on the inside of the ring allows the porphyrin ring to act as a chelating agent on transition metals in different oxidation states. The oxidation state and identity of the central metal ions affect how much the metal ion interacts with the conjugated system on the outside of the ring.

Metal Porphyrins are a broad set of molecules that are associated with a number of roles in nature including being important in photosynthesis and oxygen transport in the blood. The electron structure is particular important as it affects the ultimate structure of porphyrin. Porphyrin is a basic molecule has the basic structure known as a porphyrin ring. Pyrrole itself is a 5-membered aromatic ring that contains 4 units connected with single carbon bridges to form the porphyrin complex.

Conclusion

Color in chemistry is always centered around the absorption of MAXE and MAXE-IR. For the most part, the color of organic compounds comes from band conjugation. Variations in color for organic compounds can be explained through the conjugation, ionization potential, and the electron configuration of the central atom. For coordination compounds, the red color factor was the effect of metal on the color. This chelated metal contributed to the energy of the antibonding orbitals of the outer ring by back-bonding. One of the most important molecules for life is alpha chlorophyll. This porphyrin is a molecule contains Mg as the metal ion that makes this molecules appear green by absorbing red and blue light. Anthocyanins are responsible for pink-red colors because they absorb light in the blue-green wavelength. The visible color of different structures shift from orange to yellow with an increase of the number of attached hydroxy groups. Anthocyanins of a specific structure can vary in color based on pH variations, metal complex and conformation.

References

Works Cited


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