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Anthocynanins

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What are Anthocyanins?

Anthocyanins are water soluble pigments (Khoo 1). They are 1 of 6 flavonoids, groups of plant chemicals (Galvano 1). They are often credited with the blue, red, and purple colors in some plants, fruits, and vegetables (Khoo 1). They are antioxidants, which protect cells from damage caused by free radicals (Zoersel 1)

Fig. 1, by Northwest Wild, found on Google Images

Fig. 2, by Pense Nursery, found on Google Images

Fig. 3, by Hidden Valley Hibiscus, found on Google Images

Where are they Found

Anthocyanins are commonly found in fruits and vegetables that are bright and strong in color (Khoo 1). They are commonly purple and blue.(Khoo 1). Common examples of where anthocyanins can be found include berries, currants, grapes, onions, eggplants, wine, blood oranges, red cabbage, purple potatoes, etc (Khoo 1).

Fig. 4, by Chengyu Zheng on Organicbiz, found on Google Images

Fig. 5, by Indiamart, found on Google Images

Fig. 6, by Solluna, found on Google Images.

Anthocyanin Chemical Characteristics

- Donates electrons to proteins (Neill 8)
- Hard and soft electrophiles (Neill 8)
  - An electrophile or Lewis acid is a molecule that accepts bonding electron to form a bond to its reacting companion (Shapely).
- Hard and soft nucleophiles (Neill 8)
  - A nucleophile or Lewis base is a molecule or ion that gives a pair of electrons to form a covalent bond (Shapely).
  - Hard nucleophiles contain small electronegative atoms(McDermott).
  - Soft nucleophiles contain larger atoms (McDermott).

Fig. 9, on UCLA, found on Google Images

Anthocyanin Chemical Characteristics Continued

- Water soluble (Neill 8)
- Develops π-stacking interactions (Neill 8)
  - Also known as aromatic stacking which is the noncovalent interactions between aromatic rings. These rings contain pi bonds (“Illustrated Glossary of Organic Chemistry.”).
- Has the ability to bind hard metal ions (Dengels and Fengers 1).
- Unstable at a neutral pH (Ferrars et.al 3269)

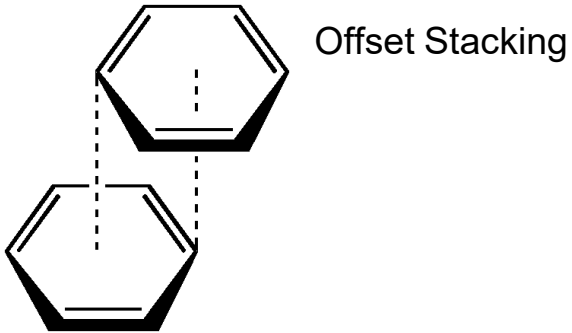

Fig. 10, on UCLA, found on Google Images

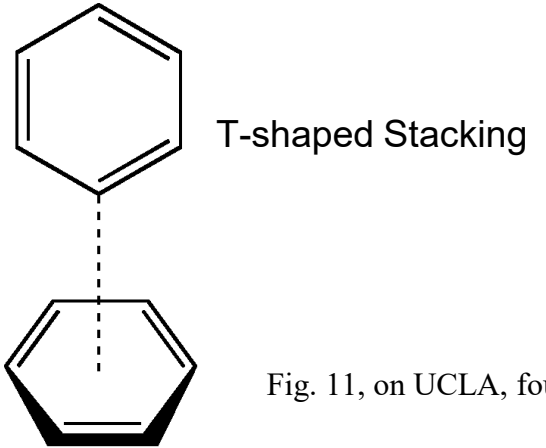

Fig. 11, on UCLA, found on Google Images

6 Different types of Anthocyanins

- Cyanidin is the most common anthocyanin that has various health benefits and antioxidant effects. (Zoersel 2).
- Malvidin is a plant pigment. Acidic conditions result in red color whereas more basic conditions result in blue-purple color. (Zoersel 2).
- Delphinidin is a plant pigment that is most stable at a basic pH level. It displays blue hues to flowers and other plants (Zoersel 2).
- Peonidin is a plant pigment that gives a red or purplish color to flowers (Zoersel 2). Found in grapes and berries (Khoo 2).
- Pelargonidin gives flowers a orange-red color and a red color to fruits (Khoo 2).
- Petunidin gives flowers and berries a dark red or purple color (Khoo 2). Found in blackcurrants and purple petals (Khoo 2).

How Anthocyanins Get Their Color

Anthocyanins are positively charged which allows them to absorb light (“General Anthocyanin Structure.”). This absorption of light results in their bright and prominent colors (“General Anthocyanin Structure.”). Anthocyanins are commonly blue and purple but can be red as well (“General Anthocyanin Structure.”). Anthocyanins are red in acidic conditions but change to blue and purple colors as pH increases (“General Anthocyanin Structure.”).

Fig. 7, by Medical News Today, found on Google Images

Fig. 2, by Pense Nursery, found on Google Images

Fig. 8, by GoMacro, found on Google Images

Environmental pH indicator

- One of anthocyanin color functions would be pH indicators (Khoo 1).
- If the pH level is less than 7 (acidic), they will portray a red/pink color (Khoo 2).
- If the pH level is 7 (neutral), they will resemble a purple color (Khoo 2).
- If the pH is above 7 (basic), their appearance is green and/or yellow (Khoo 2).
- Fun Fact: The more basic the anthocyanin is, the more colorless it becomes, stating that the colors would be dark red/pink towards a clearless yellow (Khoo 4).

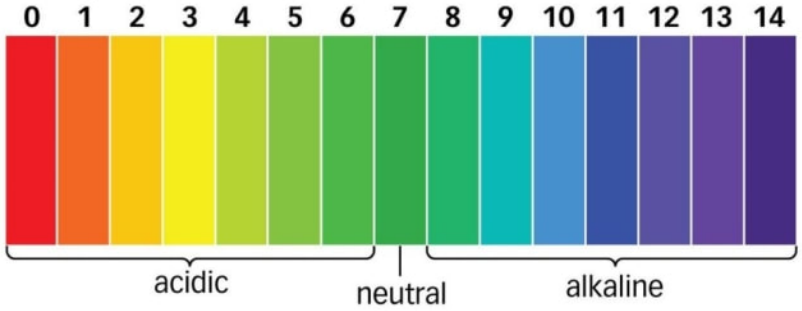

Fig. 16, by Jan San Consulting, found on Google Images

Anthocyanin Role in Plants

Anthocyanins are created in the roots of plants (Black). Anthocyanins are often found in the vacuole of plants (Neill 17). Anthocyanin pigments attract pollinators(Neill 17). Anthocyanins develop colors that better promote photosynthesis (Neill 17).

Fig. 12, by Earth, found on Google Images

Fig. 13, by Serenta Flowers, found on Google Images

Anthocyanin Plant Benefits

- Protect leaves from excessive sunlight (Horton 2).
- Helps promotes trees absorption of nutrients (Horton 2).
- Anthocyanins creation of bright colored flowers promotes pollination (Horton 2).
- Protect trees from harmful UV rays from the sun (Horton 2).

Fig. 3, by Hidden Valley Hibiscus, found on Google Images

Fig. 14, by University of Wisconsin-Madison, found on Google Images

Anthocyanin Health Benefits

- Promotes cardiovascular health due to their antioxidant properties (Galuano 4).
- Antioxidant properties helps protect cells from free radicals (Galuano 4).
- Improves skin appearance (S.L., Botanical-online).
- Helps to fight attacks on the immune system (S.L., Botanical-online).

Fig. 15, by Team180Sports, found on Google Images

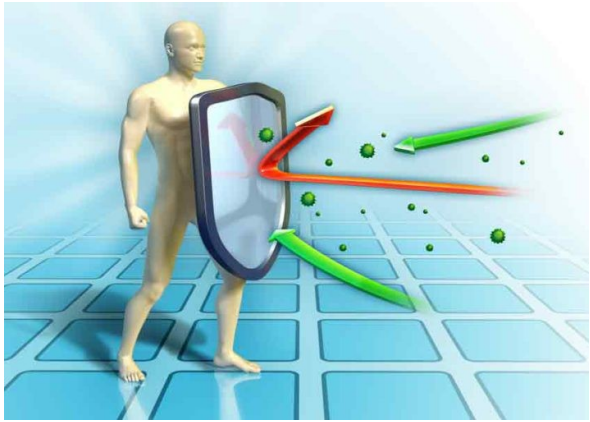

Fig. 16, by Joy!, found on Google Images

Study Researched on Anthocyanins

What & Who is being Studied

The products produced by an anthocyanin called cyanidin 3-glucoside (C3G) was observed (Ferrars et.al 3269). A 500ml pill of C3G were given to 18 healthy men (Ferrars et.al 3269).

Collected Samples

After a night of fasting blood, breath, fecal, and urine sample were taken (Ferrars et.al 3269).

Analyzation of Samples

The samples were analyzed using a high- performance liquid chromatography-electrospray ionisation tandem mass spectrometry (HPLC-ESI-MS) (Ferrars et.al 3269). HPLC-ESI-MS is a method of separating a mixture through a liquid chromatography, which separates ions and/or molecules then ionised (Perlatti, et al).

Conclusion of Study

- C3G is going through various processes within the body based on the fact various products are created and released (Ferrars et.al 3269).
- 17 metabolites were discovered in the bloodstream, 31 metabolites were found in the urine samples, and 28 metabolites were found in the feces samples (Ferrars et.al 3269)

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