

## Anthocyanin Concentration of Various Fruits and the Effect of PH



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Science Seminar



## Introduction, Part I



- Plants contain unique pigments that give them their colors. Chlorophyll produces the green pigment in plants, while carotenoids are responsible for orange colors.
- Anthocyanins are the blue, purple and red pigments found in many flowers, fruits, and vegetables.
- The reason that such plants appear more red or blue is directly due to the anthocyanin concentration in the plant.
- Anthocyanins are easily influenced by external factors such as PH, temperature, and metal concentration.

## Introduction, Part II

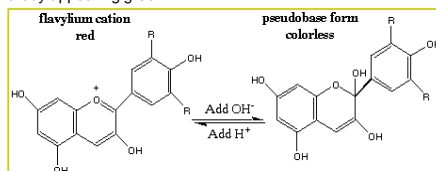


- Anthocyanins are water-soluble pigments
- Many times, the temperature that certain substances perform the best in, varies. (i.e.. Enzymes have specific temperatures for maximum performance.)
- Anthocyanins thrive in acidic solutions and therefore appear more colorful in solutions of low PH.
- Different fruits also have different anthocyanin concentrations.

## Introduction, Part III



- The Structure of the anthocyanin is what allows it to change colors in varying PH values. When in a basic solution, the anthocyanin has an extra hydroxyl which then becomes an O in an acidic solution. The addition of the OH removes the positive charge of the structure and causes the absorbance of protons of greater wavelength- thereby appearing green.

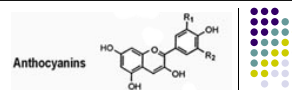


## Hypothesis



- Fruits that are more darkly colored red will be more transparent and more absorbent than fruits that are duller reds.
- The lower the PH of the solution that an anthocyanin is placed in, the more intense the red, blue, or purple the color projected will appear. As solutions become more and more basic, the color will become more muted and eventually green at a PH of 14.
- The more acidic the solution becomes, the lower the absorbance and the higher the transperence. And visa versa for basic solutions.

## Methods, Part I



Strawberries



Pears



Bing Cherries



- These 3 different types of fruit were grinded up and then placed in a spectrophotometer to measure absorbance and transperence of each fruit sample.

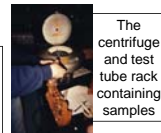
## Methods, Part II

- After the fruits were grinded, 10g of each fruit extract was combined in a test tube with 5ml of the 1% HCl methanol solution. The tubes were then diluted 20x and placed in the spectrophotometer to measure absorbance and transparency.
- A 2x diluted cherry solution was then exposed to varying levels of PH (using a hopper system to create molar solutions) and the results for each PH concentration were recorded using a test tube with 1% HCl methanol solution as the control.

## Evidence, Part I



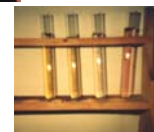
Centrifuge with fruit extracts and 1% HCl methanol solution.



The centrifuge and test tube rack containing samples



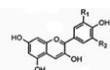
Mr. Schwebach and Me trying to work the spectrophotometer



PH = 14 – 13 – 12 – 11  
The cherry extract when it was exposed to different PH values (notice the vast color change)

## Results, Part I

Anthocyanins



Data Set # 1- Anthocyanin Concentration of different fruits

Fruit	Transparency	Absorbance
Pear	95	0.022
Strawberry	23.8	0.622
Cherry	17.1	0.766
Blank	100.3	0.001

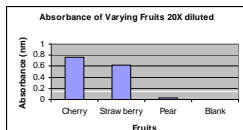


Figure 1. The graph above illustrates the absorbance of different fruits. The cherry, as the most red colored fruit, has the highest absorbance, where as the pear, which is not red at all has very little absorbance. The strawberry was moderately absorbent compared to the cherry.

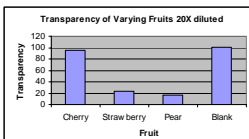
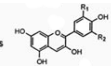


Figure 2. The graph above shows the transparency of three different kinds of fruits. It is clear that after the blank (which was set to 100%), the cherry was the most transparent followed by the strawberry and then the pear. Light traveled through the cherry more easily than it did through the strawberry and the pear.

## Results, Part II

Anthocyanins



Data Set # 2- Effect of PH on Anthocyanin transparency and absorbance

PH	Transparency	Absorbance
14	73.6	0.131
13	61.2	0.131
12	53.6	0.271
11	42.3	0.374
Blank	100.5	0.003

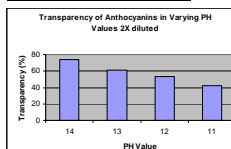


Figure 4. The Graph to above illustrates the effect of PH on the transparency of the cherry extract. When the extract was placed in a solution of a high PH (14), the transparency was very high, where as, when the PH dropped, and the solution became more and more acidic, the transparency also dropped. A more basic solution is more transparent.

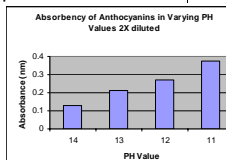


Figure 3. The graph above shows the absorbance of the cherry extract at different PH levels. The more basic the solution, the less absorbance there is. As the PH drops and the solution becomes more and more acidic, the amount of absorbance steadily increases.

## Results, Part III

- Fruits that are the darkest red are the ones with the highest absorbance and the highest transparency.
- It can be concluded that the lower the PH, the greater the absorbance of the solution, thereby the closer the color is to violet. Also, the lower the PH, the less transparent the sample would be.

## Conclusions, Part I

- With the knowledge gained from this study, the possibility of using anthocyanins in solar cells or photo-voltaic cells in order to conduct electricity can be considered.
- Also, food containing anthocyanins can be specially tailored so that it stays a certain color for a maximum amount of time.
- This study makes clear that PH has an effect on molecular properties (i.e.. color)

## Future Studies, Part I



- This experiment can be conducted in lab conditions with much more advanced conditions.
- Also, more experiments can be done to examine the anatomy of an anthocyanin and why exactly they thrive in acidic solutions.
- A larger sample can also be tested including many other fruits which contain anthocyanins.
- To examine if chlorophyll has properties similar to anthocyanins, with regards to change in PH concentration on color.
- To examine the exact effect of other factors on the color change of anthocyanins (metal presence, oxygen concentration, temperature...)