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# *Finding the Amount of Cranberry Juice in a Cranberry/Apple Juice Mix*

**Background:**

Cranberries contain phytochemicals such as anthocyanins, which give them their red color. In this lab, you will test cranberry juice at a 100% concentration to find out at what wavelength the juice absorbs the most light. You will then find the absorbance, at that wavelength, for different concentrations of cranberry juice. This data will then help you to find out how much cranberry juice is in a juice mix.

The absorbance spectrum of a sample is found with the following equation:

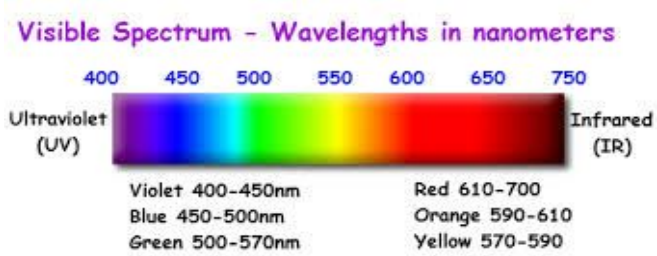
$$A = \log_{10}\left[\frac{Vo - Vd}{V - Vd}\right]$$

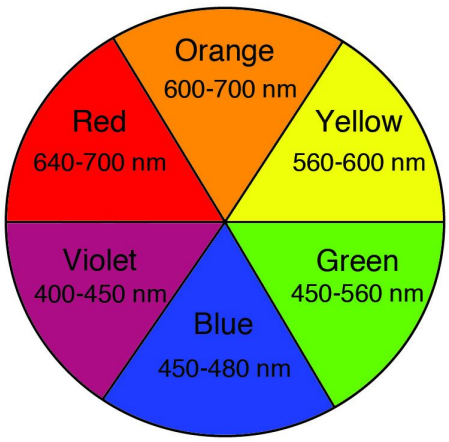
$V_0$ is the signal for the reference sample, which is what the dye will be dissolved in (water). This is typically called a background signal.
$V_d$ is the dark signal, which is a non-transmitting colloid (milk).
V is the signal of the sample (food dye dissolved in water).

Finding the angle for a wavelength of light:

$n\lambda = d \sin\theta$

$\lambda$ = *wavelength*
$\theta$ = *measured angle*
n = grating order (n=1)
d = grating line spacing (d=1000 lines/mm)



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**Aim:**

To find out the amount of cranberry juice in a cranberry juice/apple juice mix.

**Method:**

Part 1: Finding the peak absorbance wavelength for cranberry juice

___ 1) Get water, fill a cuvette with it, and place it the sample holder of the spectrophotometer.
___ 2) Turn on LED and set the multimeter to 2000 mV DC range.
___ 3) Move arm to 26° and take the voltage reading. Record in your table.
___ 4) Repeat step 3 for 28°, 30°, 32°, and 34°.
___ 5) Repeat steps 1-4, using milk to get the dark signal.
___ 6) Repeat steps 1-4 using 100% cranberry juice.
___ 7) Calculate the absorbance for cranberry juice for each angle and record in table.
___ 8) Calculate the wavelength for each of the angles you measured and record in the table. Use the visible spectrum to find out the color. Check the angle with the spectrophotometer to confirm this.
___ 9) Use the data to find the highest absorbance for the 100% cranberry juice and note the angle. This is the angle you will use for parts 2 and 3.

| **Results for Absorbance Spectrum of Cranberry Juice** | | | | | | |
|---|---|---|---|---|---|---|
| **Angle (°)** | **Wavelength (nm)** | **Wavelength Color** | **Voltage (mV)** | | | **Absorbance for Cranberry Juice** |
| | | | Water | Milk | Cranberry Juice | |
| 26 | | | | | | |
| 28 | | | | | | |
| 30 | | | | | | |
| 32 | | | | | | |
| 34 | | | | | | |

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| Calculations for Absorbance | | |
|---|---|---|
| Angle = 24 | Angle = 26 | Angle = 28 |
| $A = \text{Log}_{10}\left[\frac{V0 - Vd}{V - Vd}\right]$ | $A = \text{Log}_{10}\left[\frac{V0 - Vd}{V - Vd}\right]$ | $A = \text{Log}_{10}\left[\frac{V0 - Vd}{V - Vd}\right]$ |
| Angle = 30 | Angle = 32 | Angle = 34 |
| $A = \text{Log}_{10}\left[\frac{V0 - Vd}{V - Vd}\right]$ | $A = \text{Log}_{10}\left[\frac{V0 - Vd}{V - Vd}\right]$ | $A = \text{Log}_{10}\left[\frac{V0 - Vd}{V - Vd}\right]$ |

| Calculations for Wavelengths | | |
|---|---|---|
| Angle = 24 | Angle = 26 | Angle = 28 |
| $n\lambda = d \sin \theta$ | $n\lambda = d \sin \theta$ | $n\lambda = d \sin \theta$ |
| Angle = 30 | Angle = 32 | Angle = 34 |
| $n\lambda = d \sin \theta$ | $n\lambda = d \sin \theta$ | $n\lambda = d \sin \theta$ |

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## Part 2: Finding the absorbance spectrum for different concentrations of cranberry juice

___ 1) Record voltage and absorbance for the 100% solution of cranberry juice from previous lab in the results table.

___ 2) Get a 75% solution of cranberry juice, fill a cuvette with it, and place it the sample holder of the spectrophotometer. Turn on LED and set the multimeter to 2000 mV DC range.

___ 3) Move arm to the angle you calculated for maximum absorbance. You can use a 2x1 LEGO piece to hold the arm in place.

___ 4) Measure the voltage and record in results table below.

___ 5) Repeat steps 2-4 for 50%, 25%, and 12.5% cranberry juice.

___ 6) Calculate the absorbance for each concentration. Use your results for the milk and water from part 1.

___ 7) Create a graph plotting cranberry juice concentration (x-axis) vs. absorbance (y-axis).

| **Results for Absorbance Spectrum for Different Concentrations of Cranberry Juice** | | |
|---|---|---|
| **Concentration (%)** | **Voltage (mV)** | **Absorbance** |
| 12.5 | | |
| 25 | | |
| 50 | | |
| 75 | | |
| 100 | | |

| **75%** | **50%** | **25%** | **12.5%** |
|---|---|---|---|
| $A = \text{Log}_{10}\left[\frac{V0 - Vd}{V - Vd}\right]$ | $A = \text{Log}_{10}\left[\frac{V0 - Vd}{V - Vd}\right]$ | $A = \text{Log}_{10}\left[\frac{V0 - Vd}{V - Vd}\right]$ | $A = \text{Log}_{10}\left[\frac{V0 - Vd}{V - Vd}\right]$ |

## Part 3: Finding the concentrations of cranberry juice in a cranberry/apple

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juice mix

___ 1) Get a solution of cranberry/apple juice, fill a cuvette with it. Compare it to the concentrations of the cranberry juices and make a prediction for the % cranberry juice in it.

| | |
|---|---|
| Prediction of % Cranberry juice in Cranberry/Apple Juice mix | |

___ 2) Place the cuvette in the sample holder of the spectrophotometer.
___ 3) Turn on LED and set the multimeter to 2000 mV DC range.
___ 4) Move arm to the angle you calculated for maximum absorbance.
___ 5) Measure the voltage. Record in table.
___ 6) Calculate the absorbance and record in table.
___ 7) Use the cranberry juice graph to find out the concentration of cranberry in the cranberry/apple juice mix. Record in table and check your answer with the actual result.

| **Results for Cranberry/Apple Juice** | | |
|---|---|---|
| **Voltage (mV)** | **Absorbance** | **Concentration (%)** |
| | | |

| **Cranberry/Apple Juice Mix** |
|---|
| $A = \text{Log}_{10}\left[\frac{V0 - Vd}{V - Vd}\right]$ |

**Analysis:**

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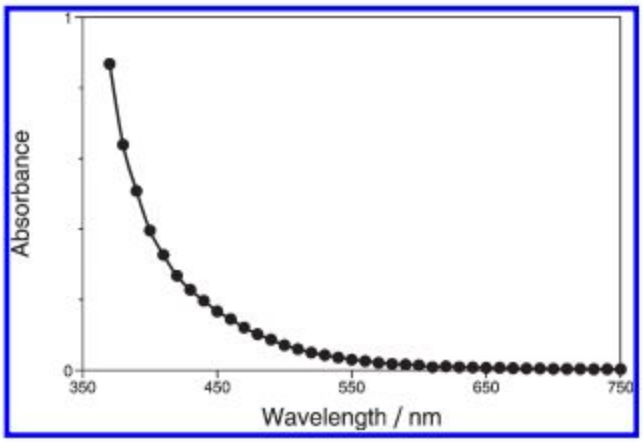
a) Below is the absorption spectrum for 100% apple juice. Look over the results and explain whether the apple juice contributes to the deep red color of the cranberry/apple juice. Cite evidence to support your answer.




_____

_____

_____

_____

b) Why did the spectrophotometer absorb green light when you measured the absorbance spectrum for the red cranberry juice?

_____

_____

_____

_____

_____