3 Visible Spectra of Commercial Dyes

Light is composed of photons with quantized wavelengths and energies. The longer the wavelength, the lower the energy. Types of light are categorized as: gamma, x-ray, ultraviolet (UV), visible (vis), infrared (IR), microwave, and radio wave, depending on the wavelength of the photon. The light that our eyes can detect, conveniently referred to as the visible region, is a very small section of the light spectrum.

Spectrophotometry is the study of the transmission or absorbance of light through a substance. Transmittance is a measure of the amount of light passing through a substance; absorbance is the amount of light that was captured by a substance. A clear colorless piece of glass has close to100% transmittance and 0 absorbance of visible light. In colored liquids, for example, the color we see is a result of the different wavelengths and total amount of light that the liquid absorbed.

In this experiment, you will use a Vernier Spectrometer (V-SPEC) to identify the dyes found in commercial products. Different dyes absorb at different wavelengths. You will measure the absorbance of food dyes, mixed with water, over the 380 – 950 nm range and compare the spectra of the dyes to the spectra of various commercial products.

OBJECTIVES

In this experiment, you will

- Measure and analyze the visible light absorbance spectrum of various samples of aqueous food dye mixtures to determine the absorbance spectrum for each sample.
- Compare and contrast the spectra of various food dye mixtures.
- Measure a sample of a commercial liquid product and identify the food dyes used to color the product.

MATERIALS

Vernier Spectrometer
computer
one cuvette
250 mL beakers for food dyes samples
100 mL graduated cylinder
plastic Beral pipets
food dyes
commercial drink or mouthwash
distilled water
stirring rod
tissues (preferably lint-free)

PROCEDURE

1. Obtain and wear goggles.
2. Use a USB cable to connect a Vernier Spectrometer to your computer.
3. Start the Logger *Pro* 3.4.5 program on your computer.
4. Record the type of food dyes that you will be testing (such as Red #40, Blue #1, Yellow #5). Prepare each sample by dissolving 2 drops of a food dye in 100 mL of distilled water.
5. To set up the Vernier Spectrometer, open the Experiment menu and select Connect Interface → Spectrometer → Scan for Spectrometers.
6. Calibrate the Spectrometer.
   a. Prepare a *blank* by filling an empty cuvette ¾ full with distilled water.
   b. Open the Experiment menu and select Calibrate → (Spectrometer). The following message appears in the Calibrate dialog box: "Waiting … seconds for the device to warm up." After 60 seconds, the message changes to: "Warmup complete."
   c. Place the blank in the cuvette holder of the Spectrometer. Align the cuvette so that the clear sides are facing the light source of the Spectrometer. Click "Finish Calibration", and then click OK.
7. Conduct a full spectrum analysis of a food dye sample.
   a. Empty the blank cuvette and rinse it twice with small amounts of a food dye mixture. Fill the cuvette ¾ full with the food dye mixture and place it in the spectrometer. Align the cuvette so that the clear sides are facing the light source of the spectrometer.
   b. Click Collect. A full spectrum graph of the food dye sample will be displayed.
   c. Examine the graph, noting the peak or peaks of very high absorbance or other distinguishing features. Save and/or print a copy of the graph.
8. Repeat Step 7 with the remaining food dye samples. Remember to keep a copy of each graph.
9. Obtain a sample of a commercial product containing a dye, such as a mouthwash or beverage. Repeat Step 7 with the commercial product.
10. Select Exit from the File menu to close down Logger *Pro* 3.

DATA TABLE

Trial	Food Dye (or product)	Peaks or unique features of the spectrum
1		
2		
3		
4		

DATA ANALYSIS

1. Describe, in detail, the spectrum of each food dye sample. Emphasize the features of each spectrum that distinguishes it from the other food dyes.

2. Identify the wavelengths and absorbance values of every peak in the graph of each food dye.

3. Identify the food dye or dyes present in the commercial product that you tested. Support your identification with specific information from your testing.