



EDUCATION EXPERIMENT



Spectrophotometric Characterization of Spice Extracts

Introduction

Spices have a long and rich history around the world. In some senses (pun intended), the cuisine of a particular region identifies itself with specific local spices. For centuries, spices have been used to modify the flavor of prepared foods, help preserve foods and act as herbal remedies for a wide variety of real and imagined ills.

Along with the important role of contributing to the flavors of foods, spices are also employed to modify the color of foods. Turmeric adds a strong yellow tinge to curries while saffron offers a softer yellow to paellas. Paprika contributes a deep, vibrant red to chicken paprikash as well as presenting a vivid, flavorful spice garnish to simple cottage cheese.

In this experiment, you will use isopropanol, also known as rubbing alcohol, to prepare extracts of a selection of spices. You will then use an Ocean Optics spectrometer and light source to measure the visible light absorbance spectra of several known spice extracts. Once you have built your "database" of known spice spectra, you will measure the absorbance spectra of an unknown spice sample and compare it to your spectral database to determine the identity of the unknown spice.



www.oceanoptics.com



info@oceanoptics.com



US +1 727-733-2447

EUROPE +31 26-3190500

ASIA +86 21-6295-6600

| SPECTROMETERS |

| ACCESSORIES |

| SUBSYSTEMS |

| COMPLETE SOLUTIONS |

Materials

- FLAME-CHEM-VIS-NIR spectrophotometer with integrated light source and cuvette holder (or standalone light source, cuvette holder and optical fibers)
- Computer with OceanView software installed
- Cooking spices such as paprika, turmeric, saffron, parsley, jalapeno, cumin and curry
- 70% isopropanol (rubbing alcohol)
- Unknown spice solution prepared in 70% isopropanol (rubbing alcohol)
- 25 mL graduated cylinder
- 50 mL beakers
- Transfer/Beral pipettes
- Cuvettes

Safety

Wear safety goggles and other appropriate safety gear during the experiment. Take all proper safety precautions when handling the solutions and wear proper eye protection when working with UV light sources.

Procedure

1. Place a very small amount of each spice in a 50 mL beaker. Add 20 mL of rubbing alcohol (70% isopropanol). Swirl each beaker to mix the spices. Allow the mixtures to sit for 30 minutes while your spectrometer and light source warm up so the colorants are well dissolved and any particulate matter settles to the bottom of the beakers.
2. Connect the spectrometer to your computer using the USB cable and turn on your light source.
3. If you are using a direct attach light source, start the OceanView software. Click the **Start** button, then select **All Programs | Ocean Optics | OceanView | OceanView** or use the **Desktop shortcut**  created when you installed the software.
4. Select the **Quick View** option on the Welcome Screen and click the **Strobe/Lamp Enable** box in the **Acquisition Group Window** to turn the lamp on.



5. Allow the spectrometer and light source to warm up for at least 15 minutes.

6. Click the **Create a New Spectroscopy Application** button  in the top menu to open the **Spectroscopy Application Wizards** window.

7. Select the **Absorbance (Concentration)** option in the **Spectroscopy Wizards** window to start the Absorbance Wizard.



8. Select the **Absorbance** only option.

9. Use a transfer pipette to fill a cuvette $\sim\frac{2}{3}$ full with 70% rubbing alcohol for your reference measurement. Wipe the cuvette with a KimWipe to remove any fingerprints, place it in the cuvette holder and set your acquisition parameters in the **Set Acquisition Parameters** window.

a. Click the **Automatic button**  Integration Time **Automatic** to automatically adjust the Integration Time to the optimum value.

b. Set **Scans to Average** to 10 and **Boxcar Width** to 5 to reduce measurement noise and improve the measurement. You can set **Scans to Average** to a higher value but this will slow down your acquisitions

(total measurement time equals the number of averages multiplied by the integration time).

c. Place a checkmark in the **Nonlinearity Correction** box if this feature is available for your spectrometer.

d. Click **Next**.

10. Click the **Store Reference**  button to store a reference spectrum. Click **Next**.

11. For direct attach light sources, click the **Strobe/Lamp Enable** box to close the shutter of the light source for your Background measurement. For other light sources, block the light from entering the spectrometer. **Do not turn your light source off**. Click the **Store Background**  button to store a background spectrum.

12. If you are using a direct attach light source, click the **Strobe/Lamp Enable** box to open the shutter or unblock the light source and click **Finish**. You are now ready to measure the absorbance spectra for your spice extracts.

13. The Absorbance spectra will be displayed in the **AbsorbanceView window**. You can adjust the graph appearance using the graph tools  above the graph. For example, click the **Scale Graph Height to Fill Window** button  to zoom in on the spectrum.

14. Pour the rubbing alcohol out of the cuvette and use a transfer pipette to fill the cuvette $\sim\frac{2}{3}$ full with one of the spice extracts. Pipette the sample from the top of the solution to avoid the solids that have settled to the bottom of the beaker. Wipe the cuvette with a KimWipe to remove any fingerprints. Place it in the cuvette holder in the same orientation you used for the reference measurement. The absorbance spectrum for the extract is displayed.

15. Save your absorbance spectrum by clicking the **Configure Graph Saving** button  to configure the **File Writer**.

- Select the directory where you want to save the file.
- Enter a filename for your spectrum.
- Click **Apply** and then **Exit** to close the dialog box.

16. Click the **Save Graph to Files** button  to save your absorbance spectrum.

17. Click the **Convert Active Spectrum to Overlay**  button to overlay the spectrum so you can compare it to the spectra for the other spices in the same graph view. If you want to remove an overlaid spectrum, click the **Delete Overlay Spectrum** button . Select the spectrum you want deleted and click **OK**.

18. Pour the extract out of the cuvette, rinse the cuvette with isopropanol and use a fresh transfer pipette to fill it $\sim\frac{2}{3}$ full with another spice extract. Pipette the sample from the top of the solution to avoid the solids that have settled to the bottom of the beaker. Wipe the cuvette with a KimWipe to remove any fingerprints. Place it in the cuvette holder in the same orientation you used for the reference measurement. The absorbance plot for the solution is displayed. Repeat Steps 15-17 to save the absorbance spectrum.

19. Repeat Step 18 with your remaining spice extracts.

20. Obtain an unknown spice extract mixture. Repeat Step 18 to measure its absorbance spectrum. Compare the spectrum for your unknown spice to the spectra for your known spices to identify the unknown spice.

21. Before exiting OceanView, print a copy of the graph showing the spice extract absorbance spectra by clicking the **Print** button .

Data and Analysis

1. Print a copy of the absorbance spectra for the spice extracts that you tested, as well as the unknown spice mixture. Note the distinguishing characteristics of the spectra that helped you identify the unknown samples.

2. Which spice, or combination of spices, is contained in your unknown? Explain.

3. If distilled water had been used as the calibration blank for the spice measurements, would it have affected the absorbance measurements?

Contact us today for more information on setting up your spectroscopy system from Ocean Optics.



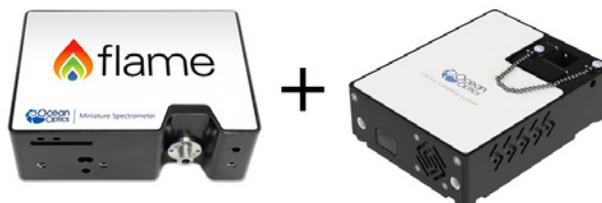
FLAME-CHEM Spectrometer Systems

Compact Spectrophotometers for Educators and Lab Pros



FLAME-CHEM-VIS-NIR

Spectral range: 350-1000 nm	Detector: Sony ILX511B linear silicon CCD array
Entrance slit: 25 μ m slit	
Integration time: 1 ms-65 seconds	Stray light: <0.05% at 600 nm



FLAME-CHEM-UV-VIS

Spectral range: 200-850 nm	Detector: Sony ILX511B linear silicon CCD array
Entrance slit: 25 μ m slit	
Integration time: 1 ms-65 seconds	Stray light: <0.10% at 435 nm



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The **Innovations in Educational Spectroscopy Grant Program** provides resources to public and private teaching institutions. The program uses spectroscopy as a general-purpose measurement tool to promote the use of modern instrumentation and technology in science and engineering curricula. Visit oceanoptics.com to learn more and apply.