Does Spectrometer Recognize a Virgin Olive Oil?

Use a spectrometer to tell apart a poor-quality olive pomace oil and virgin olive oil.

What you need

- Vernier SVIS-PL spectrometer + 4 cuvettes
- virgin olive oil
- olive pomace oil
- sunflower oil

Theoretical introduction

Olive oils

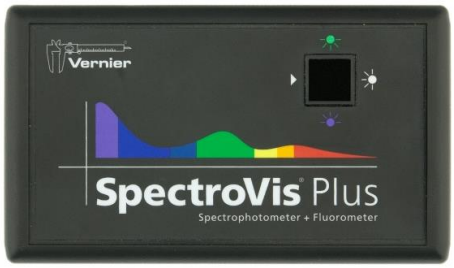
Virgin olive oil is obtained by pressing fresh olives. You can still obtain residual oil from what is left by more sophisticated procedure, for example using some chemicals, higher temperatures and pressures. During these processes, many substances are destroyed, among others the chlorophyll pigment.

Chlorophyll absorbs most photons with a wavelength of around 440 nm (blue light) and 650 nm (red light). This is the reason it appears green to us.

Furthermore, it exhibits a so called chlorophyll fluorescence, which means that its irradiation by a beam of photons with sufficient energy (you can use for example violet light with a wavelength of 405 nm) leads to absorption of the photons and emission of red photons (with lower energy).

The above mentioned properties can be used for detecting presence of chlorophyll - and thus to tell apart virgin olive oil and olive pomace oil.

Spectrometer



A spectrometer can operate in several modes. The default mode is the measurement of so called a*bsorbance.* This is a spectrometric variable the definition of which can be found for example on Wikipedia. For this experiment, it is essential that the larger the value of the absorbance of a given wavelength is the more light of given wavelength is absorbed by a substance in the cuvette.

When measuring the absorbance, insert the cuvette into the shaft of the spectrometer – in the picture the shaft opening is in the top right corner. To the right of the shaft there is a mark of a white light source (white circle with rays). The light shines through the cuvette; each individual wavelength is absorbed to a different degree. Photons continue towards the detector (in the picture marked by a white triangle).

The detector measures the amount of light of each wavelength. First, we perform a calibration measurement with an empty cuvette. Thereafter, we can measure the absorbance of each sample.

When studying the fluorescence, the light source positioned directly opposite the detector is turned off. Instead, a violet light source (405 nm) shining from the side is lit. If violet light is absorbed by the substance in the cuvette and the substance emits red photons instead, the detector detects a part of these photons.

Tasks

Spectrometer preparation

1. Connect the Vernier SVIS-PL spectrometer to your PC via USB.
2. In the menu, select *Experiment > Calibrate > Spectrometer*.
3. Wait for 90 seconds while the light source of the spectrometer heats up.
4. Insert an empty cuvette - beware of a proper position and placement of the cuvette. Two opposite grooved sides are used for holding the cuvette; when measuring absorbance, the light shines through the two opposite smooth sides.
5. Finish the calibration.

Absorbance measurement

1. Insert a cuvette filled with sunflower oil into the spectrometer; start the measurement, wait for a few seconds until the values stabilize, and then stop the measurement. Store the latest run by *Experiment > Store Latest Run*

2. Repeat Step 1 for olive pomace oil and virgin olive oil.

3. Compare the curves.

Fluorescence measurement

1. In the menu, select *Experiment > Change units > Spectrometer > 405 nm fluorescence*.

2. Perform the same three measurements as in the absorbance measurement. This time, the higher value in the graph means a larger quantity of emitted light of a given wavelength (in contrast to absorbance measurement, where a larger value meant a greater absorption).

3. Compare the curves.