Lasers and fluorescence in olive oil

(Belgium)

Background

Fluorescence describes a phenomenon where light is emitted by an atom or molecule that has absorbed light or electromagnetic radiation from another source. When a fluorescent substance absorbs electromagnetic radiation, electrons in its atoms become excited – that is, electrons in the molecule temporarily transition from the ground state to an excited state. On returning to the ground state, light of a certain colour is emitted. Different colours of light have different amounts of energy. In most cases, the emitted light has a longer wavelength, and therefore lower energy, than the absorbed electromagnetic radiation.

You will need:

- ✓ Extra virgin olive oil
- ✓ Water
- ✓ Medium sized Beaker
- ✓ Green laser and a purple laser from aliexpress.com

Follow these steps:

1. Add 250 ml of water to a medium sized 500 ml beaker.
2. Add 150 ml of extra virgin olive oil to the top of the water in the beaker.
3. Shine a green laser into the beaker containing the olive oil and water. Record observations.
4. Shine a purple laser light into the beaker containing the olive oil and water. Record observations.

So what happened?

The green laser beam fluoresces red in the extra virgin olive oil. Molecules in the olive oil absorb energy from the green laser and become excited. On returning to their ground state, they emit light of a longer wavelength red (lower energy).

The olive oil has a refractive index of approximately 1.44 – 1.47, so the laser beam refracts towards the normal. The beam then enters water and refracts away from the normal. The refractive index of water is approximately 1.33.

What next?

- Extra Virgin olive oil is more expensive than other vegetable oils. Can you distinguish an extra virgin olive oil from other oils (e.g. sunflower oil/corn oil) using a laser light?
- Investigate the fluorescent properties of Quinine using Tonic water, a green laser and a violet laser.