Chlorophyll fluorescense

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Fluorescense of chlorophyll

1. Materials

- some green leaves (e.g. basil or spinach)
- ethanol (95%) or hand sanitizer
- 1 mortar
- 1 mortar pestle
- 1 transparent glass beaker
- 1 filter
- 1 funnel
- 1 lamp
- 1 uv-lamp (or blue laser)

2.

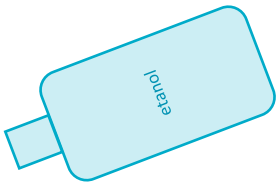
Tear the leaves into small pieces,

put them in a mortar...

... and crush the leaves into a mushy paste.

Fluorescense of chlorophyll

3. Pour ethanol over the leaves until they are covered and stir.



4. Place the filter in the funnel over the beaker, pour the leaf mash into the filter ...

...and wait until the liquid has flowed through.

5.

Shine with a regular lamp, than with UV light or a blue laser on the extract.

What happens?

When you shine a UV light or with a blue laser on the liquid, it glows in a strong red color.

If you only have a regular lamp, the extract will also look reddish, but not as clear.

Explanation

By mashing the leaves and mixing the mash with ethanol, you release the pigment chlorophyll. When you direct the UV light at the chlorophyll extract, the molecules in the mixture become electronically stimulated: the electrons in the molecules are raised to a higher energy level. However, this is an unstable state. When the electron returns to the ground state, the molecules release the newly gained energy. The process takes place with the emission of light. This phenomenon is called fluorescence.

Recess

Molecules have different "bands" within discrete energy levels due to the translational, rotational, and vibrational variation in energy that can occur due to the electron bonds. When energy is absorbed by a molecule such as chlorophyll from sources such as UV light photons, electrons will be promoted from the ground state (S0) to an excited band (S1 or S2). When the molecule emits the absorbed energy, the electron will return to the ground energy state. This phenomenon is called fluorescence. In the case of the spinach used in this experiment, the pigment chlorophyll, which naturally absorbs blue and red wavelengths of light, is released, thus emitting a green color under natural light. When the UV light is placed next to the chlorophyll solution, electrons are promoted from the S0 state to the S2 state. The pigment then only absorbs the blue-violet wavelength range. The electrons will fluoresce and the red color is observed.

Fluorescense of chlorophyll in nature

The plants absorb the sun's light, which consists of all visible colors, and use it for photosynthesis. The goal is to store the solar energy as glucose. But not all energy can be used in the process and is emitted as heat or as red light. This is chlorophyll fluorescence. The video shows what the fluorescence looks like: https://www.youtube.com/watch?v=25w7n9X15r8. Scientists use the fluorescence to measure photosynthetic activity of plants. This analysis can be used to make statements about the state of photosystem and to investigate how plants react under stress (eg if they are getting too little water or nutrients or too much sunlight).

You can download the activity by scanning the QR-code: