Sunscreen structures

Education in Chemistry
July 2019
rsc.li/2L5WHqi

Certain functional groups play an important role in providing sunscreen chemicals with their UV-absorbing properties. Read the article on reef-friendly sunscreens and answer the questions below.

1. On 1 January 2020, the Pacific Island of Palau will become the first country to ban all sunscreens that contain any one of 10 chemicals.

   The structure and names of three of these banned chemicals are shown in Figure 1.

   ![Figure 1](image-url)

   **Figure 1**

   oxybenzone

   octinoxate

   octocrylene

a. Highlight the following functional groups on the structures given in Figure 1;
   i. alkene
   ii. alcohol
   iii. ester

b. All of the molecules in Figure 1 have UV protecting properties.

   Their ability to absorb UV radiation is based on their structure.

   Look at the structures of the molecules.

   i. How are the structures of oxybenzone and octinoxate similar?
   ii. How are the structures of octinoxate and octocrylene similar?
c. The molecules in Figure 1 are all able to absorb UV radiation because they contain a conjugated system.

A conjugated system is when every other bond is a double (\(=\)) or triple (\(≡\)) bond. The double/triple bond can be between two carbon atoms, or a carbon atom and any other type of atom.

The conjugated system in oxybenzone is highlighted in Figure 2 below.

![Figure 2](image)

Highlight the conjugated system in octinoxate and octocrylene on the diagrams in Figure 1.

**Extension:** Dutch researchers have developed a new form of sunscreen in which natural UV protectants are encapsulated in a coating of natural polymers.

Find out the structures of the three natural UV protectants; quercetin, retinol and p-coumaric acid mentioned in the article.

Explain why these molecules are all able to absorb UV radiation.

2. The LC\(_{50}\) of a chemical is a measure of the toxicity of that chemical. It is the lethal dose in which 50% of the population is killed in a given time period.

A recent study reported the LC\(_{50}\) for planulae, the larval form of the coral *Stylophora pistillata*, exposed to oxybenzone in the light over an 8 h period to be 3.1 mg/L.

1000 mg = 1 g; 1 L = 1 dm\(^3\)

a. Calculate the molar mass of oxybenzone.

b. Determine the LC\(_{50}\) of oxybenzone in units of mol/dm\(^3\).