# Transfer of energy between curcumin and Nile Red in egg and cholesterol lecithin model membranes

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# Summary

The aim of this experimental activity is to study the transfer of energy between curcumin and Nile Red. Curcumin is used as a natural drug and Nile Red as a fluorescent molecule which, by absorbing the energy of curcumin, will emit it in fluorescence, thus allowing to verify its presence in the phospholipid bilayer.

# Introduction

This activity fits into the field of Biophysics and Bionanosystems and it is one of the activities within the Matters of Matter project.

This experimental activity can be applied in studies of the position of drugs in biological membranes, in the study of the influence of membrane composition on the position of drugs and in applications in lipid-based drug-delivery systems such as liposomes, magnetoliposomes, etc. Various drugs can be used; in this experiment a natural drug - curcumin - is used. Curcumin can be found in Indian saffron, also known as turmeric, and it has antioxidant, anti-inflammatory, antimicrobial and anticancer properties.

Nile Red, a fluorescent probe, is used to identify the drug, which absorbs the energy that curcumin emits at the wavelength of 410 nm, emitting this energy at the wavelength of 510 nm in the form of fluorescence; curcumin acts as an energy donor and the Nile Red as an acceptor. This energy transfer occurs only if they are within a distance of less than 10 nm within the phospholipid bilayers, which consist of cholesterol, phospholipids, glycolipids and proteins. The aim of this experiment is to verify the transfer of energy between curcumin and Nile Red in egg and cholesterol lecithin model membranes. Lecithin is a mixture of glycolipids, triglycerides and phospholipids, and the phospholipid obtained from the egg yolk is called phosphatidylcholine.

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# Curriculum / subjects

Biology - year 11 and 12

Biophysics

# Material

- Nile Red solution
- curcumin
- phosphatidylcholine
- ethanol
- Pasteur pipettes
- 3 test tubes
- spectrofluorimeter

# Experimental Procedure

Three test tubes are prepared with phospholipids and cholesterol. In the first test tube, curcumin was added; in the second, Nile Red and in the third, both curcumin and Nile Red.

Secondly, the solvent is evaporated and ethanol is added to all the test tubes, as the phospholipids, especially the phosphatidylcholine obtained from the egg yolk, have good solubility in ethanol.

Next, water is added drop-by-drop to the various solutions; the slower the water is added, the better to organize the formation of the phospholipid bilayers. This layer consists of cholesterol and phospholipids.

Finally, each solution is brought to the spectrofluorimeter to measure the fluorescence intensity.

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# Data collection and analysis

Curcumin is excited at the wavelength of 410 nm, absorbing light and emitting part of the absorbed energy in the form of fluorescence.

In Figure 1, we can observe that the Nile Red practically does not absorb light at the wavelength of 410 nm, but it already absorbs it at 510 nm.

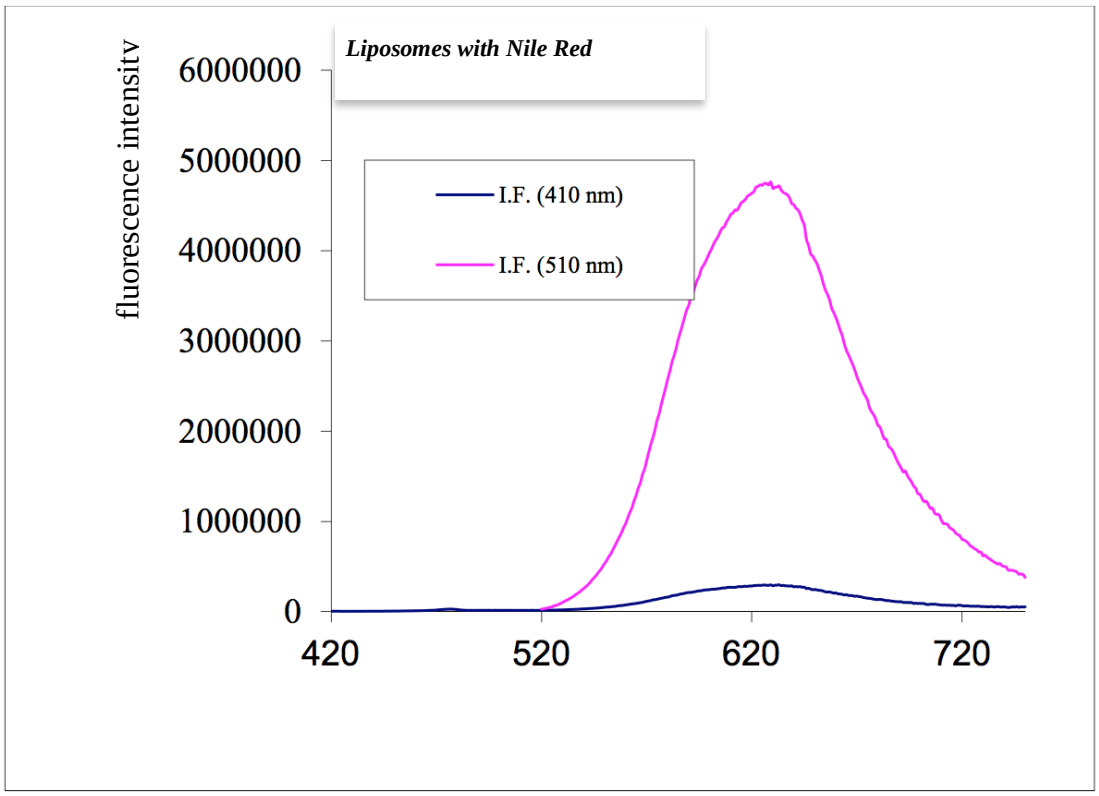


Figure 1 - Emission of Nile Red fluorescence in membranes

It is possible to observe that curcumin emits fluorescence in the wavelength region where the Nile Red absorbs it. So the Nile Red can absorb some of the energy that the curcumin would emit in the form of light. Therefore, curcumin works as an energy donor and the Nile Red as an acceptor.

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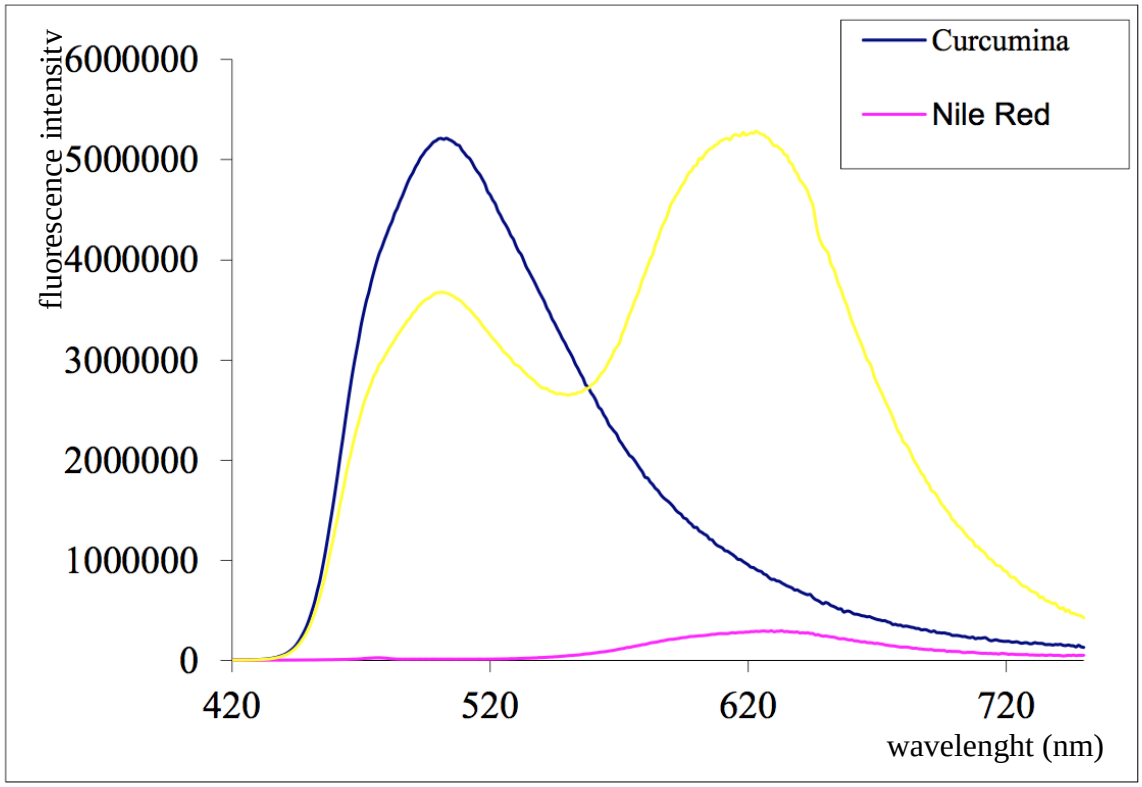


Figure 2 - Curcumin and Nile Red in membranes

The emission of curcumin fluorescence decreases due to the transfer of energy to the Nile Red.

It was verified that the Nile Red emits strong fluorescence in the membranes, even if it is not directly excited, because it receives energy from the curcumin and afterwards it releases it. Therefore, the drug curcumin is located in the membranes, at a distance from the Nile Red under 10 nm.

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# Conclusion

In this process we observed the transfer of energy between Curcumin and Nile Red in phospholipid bilayers, as the distance between them was less than 10 nm.

As a result, it is concluded that this process can be used in the localization of drugs in biological membranes and in other areas of investigation, such as in the treatment of tumours, as it would not affect other cells unlike the current treatments.

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