OPTICAL DETECTION OF RHODAMINE B BY Pt(II) TETRA-(4-ALLYLOXY-PHENYL)-PORPHYRIN

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Abstract
Rhodamine B is a red, water-soluble synthetic dye with multiple uses in cosmetics, textiles, medicines, food, plastics. Nevertheless, the colorant is toxic causing irritation of the skin, eyes, and airways. For this reason, the control of foods and cosmetics is a must. The present study reports a simple and fast UV-vis spectrophotometric method for the detection of rhodamine B by using as sensitive material Pt(II)-tetra-(4-allyloxy-phenyl)-porphyrin. The method is viable in the range of rhodamine B concentrations from 1.94 $x10^{-6}$M to 4.26 $x10^{-5}$M with very good accuracy.

Introduction
Rhodamine B, represented in Figure 1a, is a red, water-soluble synthetic dye that is part of the xanthine class [1]. Due to its intense color, rhodamine B has been extensively used as a dye in industrial applications such as cosmetics, textiles, medicines, food, plastics [2]. Besides, being a strong fluorescent compound, rhodamine is also used in biotechnological applications such as fluorescence microscopy and flow cytometry [3]. Rhodamine B dyes are generally toxic to humans and animals, causing irritation of the skin, eyes, and airways [4] and is soluble in polar solvents, such as: water, methanol and ethanol. Due to its harmful effects it is of great importance to develop a simple and fast method for recognizing and determining of rhodamine content in different samples.
Various techniques were used in the last years for the specific determination of rhodamine as follows: rhodamine content in tap water by UV-VIS spectroscopy with a limit of detection of 1.47μg/L [3]; rhodamine presence in ballpoint pen inks by high performance liquid spectrophotometry [5] and the presence of unauthorized rhodamine B colorant in foods (curry paste and chili sauce) by capillary chromatography [6]. The purpose of our study was to achieve a simple and efficient method for the detection of Rhodamine B as unauthorized colorant in different foods and tap waters, by using as sensitive material a novel synthesized Pt-porphyrin, namely Pt(II) tetra-(4-allyloxy-phenyl)-porphyrin (**Pt-TAPP**) (structure presented in Figure 1b).

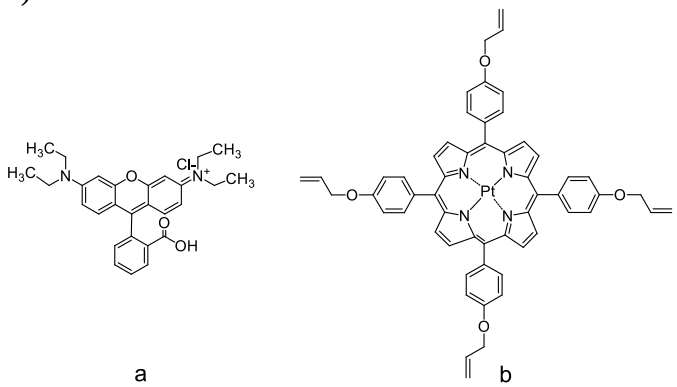

Figure 1. a) The structure of rhodamine B; b) the structure of **Pt-TAPP** metalloporphyrin

Materials and methods

Reagents

Dimethyl sulfoxide (DMSO) was purchased from Merck (Darmstadt, Germany), rhodamine B is provided by Polske Odczynniki Chemiczne (Gliwice, Poland). The platinum metalloporphyrin Pt(II)-5,10,15,20-tetrakis-(4-allyloxyphenyl)-porphyrin was synthesized in our laboratory by classical metallation reaction performed in chlorobenzene [7] using as salt the platinum soluble complex $PtCl_2(PhCN)_2$ an a molar ratio of 1:1.5 between the porphyrin base and the platinum salt.

Method

The experiments were performed in 5 mL porphyrin solutions in DMSO with concentration of 9.93×10^{-6} M, to which for the first 5 experiments 0.05 mL of rhodamine B solution with concentration of 2.004×10^{-5} M, were added and for the next, the rhodamine B additions were increased to 0.1 mL. The mixtures were stirred for 1 minute and then the UV-vis spectrum was recorded for each step.

Apparatus

For recording of the UV-visible spectra a JASCO UV- V-650 spectrometer (Japan) and standard 1 cm pass quartz cells were used.

Results and Discussions

The UV-vis spectroscopy, presented in Figure 2, displays the porphyrin base electronic spectrum, typical for a metalloporphyrin, having the intense Soret band located at 409 nm and the Q band at 513nm. Besides, the rhodamine B spectrum is represented having a large absorption band with its main peak located at 560 nm, accompanied by two shoulders the first one at 475 nm and the second at 513 nm.

By increasing the rhodamine B content, the spectra change as follows: a continuous decrease of the intensity of the Soret bands is accompanied by a continuous increasing of a new band located at 550 nm. All these phenomena are associated by the appearance of three isosbestic points, one on Soret band (see Figure 2) and two on the Q band, as represented in Figure 3.

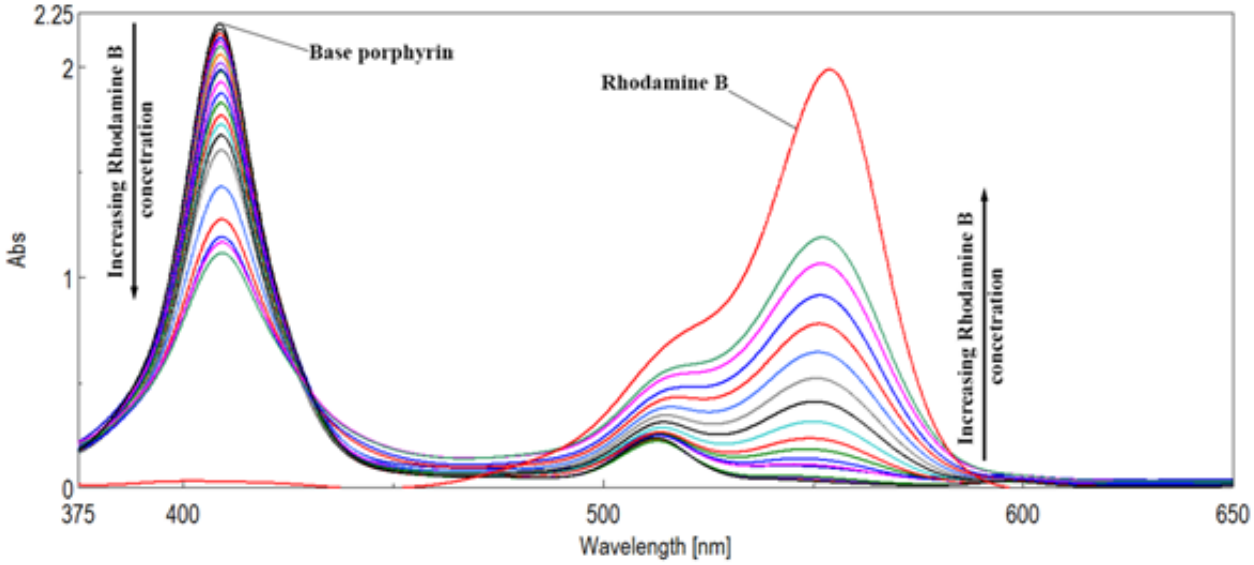

Figure 2. Overlapped UV-vis spectra monitoring the changes during rhodamine B addings

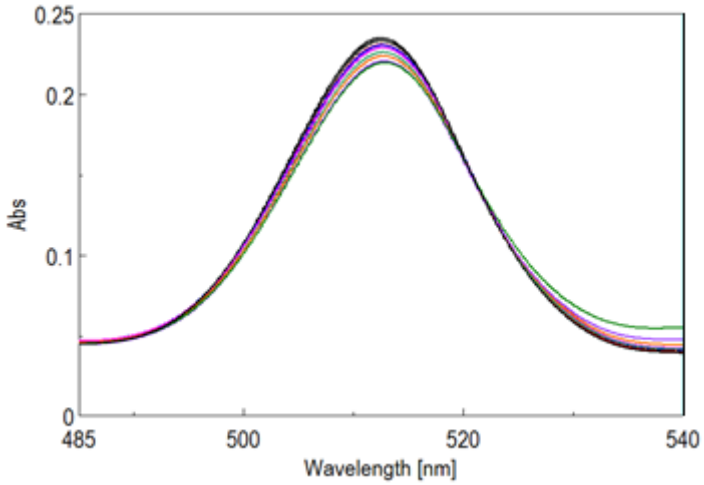

Figure 3: Isosbestic points located on Q band at 493 nm and 521 nm (the first 8 samples)

The dependence between the intensity of the new generated band from 550 nm and the rhodamine B concentration was represented in Figure 4. The dependence is linear in the rhodamine B concentration range from 1.94 x 10^{-6} M to 4.26 x 10^{-5}M, that is a large domain relevant for both food content analysis and for cosmetics control and toxicity of released waters after dyeing processes. The correlation coefficient is very good of 98%.

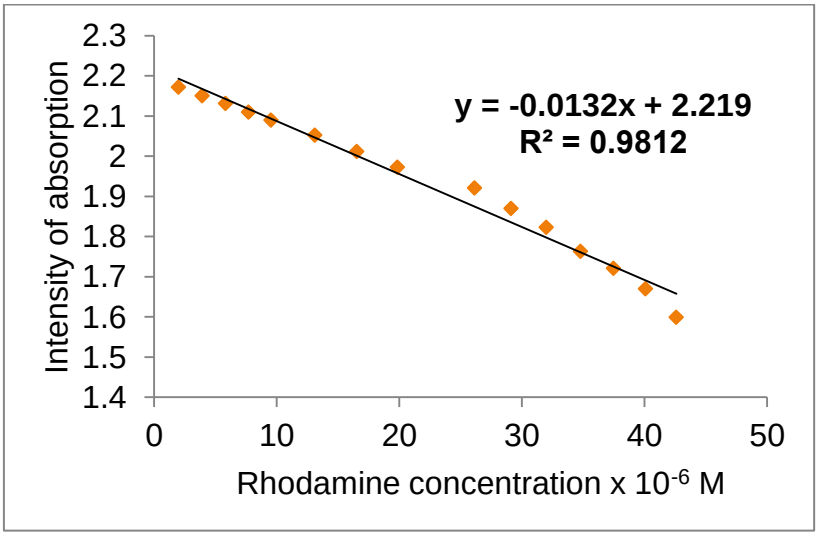

Figure 4. The dependence between the intensity of the new generated band from 550 nm and the rhodamine B concentration

Test on real samples

Tests were performed on two water samples from two different regions (Romania and France) and on a cosmetic sample (lipstick).

Following the analysis, the lack of rhodamine B was recorded in the water samples, but in the sample from cosmetics the presence of rhodamine B was identified.

Conclusion

We obtained a simple and fast UV-vis spectrophotometric method for the detection of rhodamine B applicable in the control of different foods by using as sensitive material Pt(II)-

tetra-(4-allyloxy-phenyl)-porphyrin. The method is viable with very good accuracy in the range of rhodamine B concentrations from 1.94 x 10^{-6} M to 4.26 x10^{-5} M.

Acknowledgements
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