

Studies on activated fluorouracil with optical beams, for use in the eye tumours treatment

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Abstract. The study of the photosensitiser properties of the cytostatics drugs was made since their effects could be enhanced by exposure to UV radiation at different doses. Fluorouracil (FU) solutions $2.5 \times 10^{-4} \text{M}$ in natural saline and sodium hydroxide, irradiated with optical beams emitted by N_2 laser and UV Hg classic lamp, were used. The FU was chosen due to its strong absorption along a large spectral range which makes possible the fluorescence excitation in UV spectral range. The emission fluorescence spectra were measured in the 400-550 nm range, with $\lambda_{\text{ex}} = 320$ and 350 nm for samples irradiated with Hg lamp and with $\lambda_{\text{ex}} = 360$ nm for samples radiated with N_2 laser. The excitation fluorescence spectra were measured in the range of 200-400 nm, with $\lambda_{\text{em}} = 440$ nm for samples irradiated with N_2 laser.

Key words: PDT, fluorouracil, UV spectroscopy, UV radiation, photosensitisers

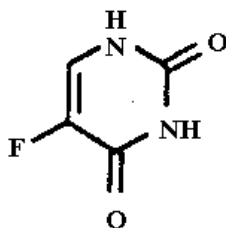
1. Introduction

Since the beginning of the last century, the photodynamic therapy became a promising technique used in the treatment of different malignant tumours. After administration of a photosensitising compound, which is activated by light, the tumour destruction by the produced active oxygen species results. The light of known wavelength, which photoactivates the tumour sensitizer must deeply penetrate into tissues and should have an efficient level of photochemical activity.

Fluorouracil (FU) belongs to the cytostatics group known as antimetabolites. It is used to treat cancer of the colon, breast, eye and pancreas.(reference no.5)

FU intervenes in cancer cells growths, which are eventually destroyed (reference no. 2).

Fluorouracil (F-2, 6-dihydroxipirimidin)



Chemical formula: $\text{C}_4\text{H}_3\text{FN}_2\text{O}_2$

Molecular weight: 130, 08 g/mol

2. Materials and methods

The absorption and fluorescence spectra were measured for FU solutions in sodium hydroxide, $2.5 \times 10^{-4} \text{M}$ concentration.(reference no. 1, 3 and 4)

The samples were irradiated for 3 to 15 minutes with a Hg lamp emitted beam at a power density of 11mW/cm^2 and with N_2 laser beam.

The emission spectrum of the Hg lamp used for the sample irradiation is given in Fig. 1.

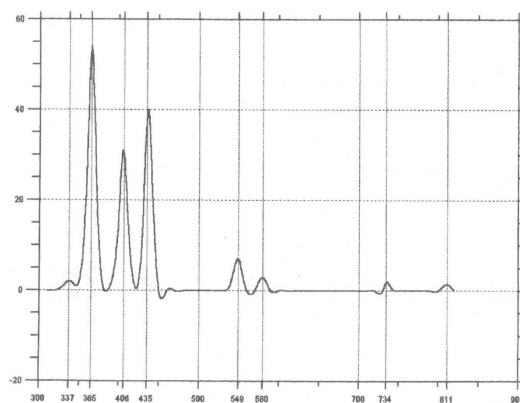


Fig.1- Emission spectrum of the Hg lamp

The absorption spectra of the samples were measured by using a Perkin Elmer UV-VIS Spectrophotometer and the excitation and emission spectra were measured with an Aminco-Bowman Spectrophotofluorimeter. The absorption spectra exhibit the spectral bands in the range of 250-450 nm.

The emission fluorescence spectra were measured in the range of 400 - 550 nm, with $\lambda_{\text{ex}} = 320$ and 350 nm for samples irradiated with Hg lamp and with $\lambda_{\text{ex}} = 360$ nm for samples irradiated with N_2 laser. The excitation fluorescence spectra were measured in the range of 200 - 400 nm, with $\lambda_{\text{em}} = 440$ nm for samples irradiated with N_2 laser.(reference no.

3. Results and discussions

3.1 Absorption spectra

The absorption spectra of the FU solution irradiated with Hg lamp, with exposure time between 2 and 10 minutes, are given in Fig.2.

Fig.3 represents the absorption spectra of the FU solution irradiated with N_2 laser, with exposure time ranging between 3 and 15 minutes. In these figures, the maximum absorption is situated at 275 nm.

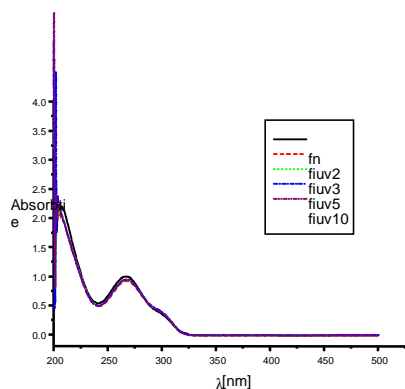


Fig.2- Absorption spectra for the sample irradiated with Hg lamp. The terms fiuvX and fiuX mean fluorouracil irradiated with Hg lamp (where X means the exposure time of the sample under irradiation).

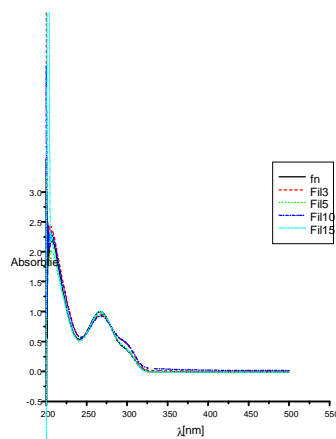


Fig.3- Absorption spectra for the sample irradiated with N₂ laser. The term filX means fluorouracil irradiated with N₂ laser (where X means the exposure time of the sample under irradiation).

There are no modifications of the shape of the absorption spectra; the spectra present the same characteristics.

3.2 Fluorescence spectra

The figures 4, 5 and 7 show the emission wavelength which it is 440nm.

a) samples irradiated with Hg lamp

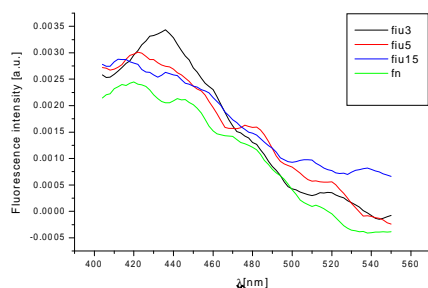


Fig.4- Emission fluorescence spectra at $\lambda_{ex}=320\text{nm}$. The terms fiuvX and fiuX mean fluorouracil irradiated with Hg lamp (where X means the exposure time of the sample under irradiation).

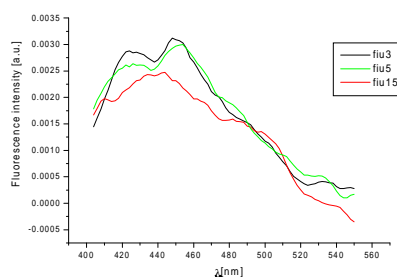


Fig 5- Emission fluorescence spectra at $\lambda_{ex}=350\text{nm}$. The terms fiuvX and fiuX mean fluorouracil irradiated with Hg lamp (where X means the exposure time of the sample under irradiation).

b) samples irradiated with N₂ laser

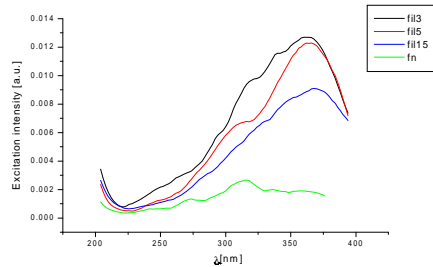


Fig.6 Excitation fluorescence spectra at $\lambda_{em}=440nm$. The term filX means fluorouracil irradiated with N_2 laser (where X means the exposure time of the sample under irradiation).

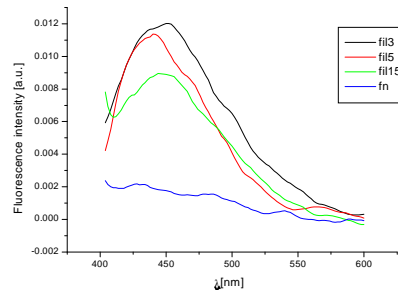


Fig.7 Emission fluorescence spectra at $\lambda_{ex}=360nm$. The term filX means fluorouracil irradiated with N_2 laser (where X means the exposure time of the sample under irradiation).

When it was made fluorescence excitation spectra (Fig.6), it was obtained the excitation wavelength between 350 and 260 nm.

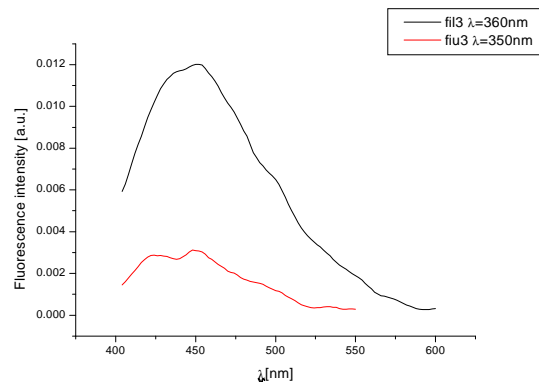


Fig. 8 Emission fluorescence spectra for Hg lamp and N_2 laser irradiated samples.

The emission fluorescence of the N_2 laser irradiated sample is higher than the emission fluorescence of the Hg lamp irradiated sample and this is shown at the same irradiation time in Fig.8 for the exposure time of 3 minutes.

4. CONCLUSIONS

The sample irradiated at $\lambda_{ex} = 320nm$ and $\lambda_{ex} = 350 nm$ with Hg lamp presented a rather important fluorescence emission and the sample irradiated with N_2 laser had the maximum fluorescence emission at $\lambda_{ex} = 360nm$.

The FU solution was exposed to different irradiation times; the solution had the maximum emission fluorescence at an irradiation time of 3 minutes. At this exposure time, the solution had the biggest photoactivity.

The sample irradiated with N_2 laser present higher emission fluorescence than the sample irradiated with Hg lamp.

The present studies are useful for clinical applications of the cytostatics as it is pointed out that besides their biochemical action the exposure to light at optimal doses could enhance their clinical effects in destroying tumour tissues.

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