Sensitizers are being used to improve the photocatalytic activity of semiconductors in the visible light region of the solar spectrum. Different types of dyes are reported as sensitizer agents, such as ruthenium complex molecules, porphyrins and Pt complexes, which are critically assessed because they are hazardous substance. Therefore, it is necessary to replace these compounds with safer sensitizer like organic dyes. This work evaluated the photocatalytic degradation of diclofenac using two different types of organic dyes (Perinaphthenone and Eosin-Y) as sensitizer agents. The catalyst concentration [0.15-0.35 g/l], source of light (UVA – Vis) and type of dye were evaluated. The data obtained can be useful to classify organic dyes that could be employees as sensitzers and which is the wavelength more adequate to use as an energy source. The Kapp for the reaction has values between $1 \times 10^{-3}$ to $5 \times 10^{-3}$ min$^{-1}$ for UVA, $3 \times 10^{-4}$ to $3 \times 10^{-3}$ min$^{-1}$ for Vis and $2 \times 10^{-3}$ to $6 \times 10^{-3}$ min$^{-1}$ for UV–Vis.
1. Data

Data present in this work describes the diclofenac degradation by photocatalysis, photosensitized oxidation, and dye-sensitized of TiO₂ using organic dyes that are a promising technique because of great result has been obtained for the degradation of several contaminants [1–4]. Table 1 shows the properties of all compounds. Fig. 1 presents the UV/vis spectra of the Perinaphthenone (Ph) and Eosin-Y (Ey) dyes used as a sensitizer agent and diclofenac (DFC), this allows knowing the maximum wavelength which absorbs energy each dye and the compound. Fig. 2 and Fig. 3 illustrate the variation of diclofenac (DFC) degradation according to the energy source Visible and UVA light, respectively. Tests of photolysis, photocatalysis and photosensitized oxidation were performed in order to identify synergies. Finally, Fig. 4 and Fig. 5 show the influence of each source of energy for dye-sensitized of TiO₂ for 0.35 g/L of catalyst concentration. In the supplementary material the raw data of Figs. 2–4 can be seen.

Table 2 shows the experimental conditions and the diclofenac degradation by photocatalysis, photolysis and dye sensitization process using Perinaphthenone (Ph) and Eosin-Y (Ey) as sensitizers.

Table 3 shows the Kapp for the degradation of DFC by TiO₂ using Perinaphthenone (Ph) and Eosin-Y (Ey) as sensitizers.

2. Experimental design, materials, and methods

2.1. Material

Diclofenac sodium (CAS 15307-79-6, Sigma Aldrich), Perinaphthenone (97% CAS 548-39-0, Sigma Aldrich) and Eosin Y (EY; Color index (C.I.) No. 45380; Fisher Chemical - ChemAlert) were used as received. The catalyst TiO₂ Degussa P-25 was obtained from Degussa Corporation (99.5% Evonik. No. CAS 13463-67-7, 80% anatase and 20% rutile crystalline phases; a specific surface area of 50 m² g⁻¹). Additionally, acetonitrile (Sigma Aldrich, 99.99% analytical grade) and formic acid (Sigma Aldrich,
reagent grade ≥95%) were used for the mobile phase. For experimental tests water purified by a Millipore Milli-Q device was used.

2.2. Reactive system

Photocatalytic reactions were performed in a batch reactor (Pyrex glass bottle) illuminated from the top in a device equipped with six fluorescent tubes interchangeable. UVA light was emitted by tubes TLAD 30W05 Philips with wavelengths between 300 and 450 nm and a maximum at 365 nm [5,6]. Visible lamps Sylvania F30W, emitting above 400 nm were used. The temperature was kept constant to 27 ± 2 °C and air was supplied to each system with a flow rate of 2 L/min to maintain the concentration of dissolved oxygen constant. Fig. 6 shows a scheme of the device.

![Fig. 1. Absorption spectra of the compound used. (a) organic dyes [Dye] = 4 mg/L. (b) Diclofenac [30 mg/L].](image-url)
2.3. Experimental

DCF solution was prepared at 30 mg/L. The reaction volume was 0.25 L. TiO2 concentrations and the dye sensitizer (Eosin Y or Perinaphthenone) were added simultaneously [1,7]. Subsequently, the reactive system was stirred magnetically in darkness for 30 minutes in order to promote the adsorption of DCF and the sensitizer onto the catalyst surface [8,9]. After the adsorption period, the slurry was irradiated for a period of 150 minutes. Aliquots (2 ml) were taken at different intervals to perform analyzes. All tests were repeated three times to ensure the data reproducibility.
2.4. Analytical techniques

High-resolution liquid chromatography (HPLC) Thermo scientific ultimate 3000 with a diode array detector (DAD) was used to determine the concentration of DCF using a LiChrosphere® 100 RP-18 column (5μm). A mixture of 35% water (10mM formic acid) and 65% acetonitrile operated in isocratic mode was used as mobile phase at a flow rate of 0.85 ml/min. To obtain the dye spectra UV–Vis 1800 spectrophotometer was used.
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Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Table 2
Experimental conditions and diclofenac degradation by photolysis, photocatalysis and dye sensitization process.

| [TiO2] = 0.15 g/L | UVA | Visible | UVA+Visible |
|------------------|-----|---------|-------------|
|                  | [DCF] final mg/L | % deg | [DCF] final mg/L | % deg | [DCF] final mg/L | % deg | pH (±0.3) |
| Photolysis       | 25.6 | 14.7   | 28.8 | 4.0 | – | – | 6.8 |
| TiO2-DCF         | 15.7 | 47.7   | 27.0 | 10.0 | 18.9 | 37.0 | 7.2 |
| Ph-DCF           | 16.6 | 44.7   | 19.9 | 33.7 | 13.9 | 53.7 | 7.3 |
| EY-DCF           | 23.6 | 21.3   | 18.0 | 40.0 | 21.1 | 29.7 | 7.1 |
| TiO2-Ph-DCF      | 13.0 | 56.7   | 16.0 | 46.7 | 13.6 | 54.7 | 7.2 |
| TiO2-EY-DCF      | 18.6 | 38.0   | 14.6 | 51.3 | 17.2 | 42.7 | 7.2 |
| [TiO2] = 0.35 g/L|     |        |       |     |     |     |       |
| TiO2-DCF         | 15.0 | 47.7   | 20.3 | 32.2 | 16.7 | 44.2 | 7.1 |
| TiO2-Ph-DCF      | 13.4 | 55.3   | 18.8 | 37.3 | 12.3 | 59.0 | 7.4 |
| TiO2-EY-DCF      | 17.1 | 42.9   | 18.6 | 37.8 | 16.04 | 46.5 | 7.4 |

Table 3
Kapp for diclofenac degradation by photolysis, photocatalysis and dye sensitization process os TiO2.

|                      | UVA (Kapp min\(^{-1}\)) | Visible (Kapp min\(^{-1}\)) | UVA+Visible (Kapp min\(^{-1}\)) |
|----------------------|----------------------------|-----------------------------|---------------------------------|
| Photolysis           | 1 x 10\(^{-3}\) ± 7 x 10\(^{-5}\) | 3 x 10\(^{-4}\) ± 2 x 10\(^{-5}\) | –                                |
| TiO2-DCF             | 4 x 10\(^{-3}\) ± 2 x 10\(^{-4}\) | 7 x 10\(^{-4}\) ± 4 x 10\(^{-5}\) | –                                |
| Ph-DCF               | 4 x 10\(^{-3}\) ± 2 x 10\(^{-4}\) | 3 x 10\(^{-3}\) ± 1 x 10\(^{-4}\) | 6 x 10\(^{-3}\) ± 2 x 10\(^{-5}\) |
| EY-DCF               | 1 x 10\(^{-3}\) ± 7 x 10\(^{-5}\) | 4 x 10\(^{-3}\) ± 2 x 10\(^{-4}\) | 2 x 10\(^{-3}\) ± 4 x 10\(^{-5}\) |
| TiO2-Ph-DCF          | 5 x 10\(^{-3}\) ± 3 x 10\(^{-4}\) | 4 x 10\(^{-3}\) ± 2 x 10\(^{-4}\) | 6 x 10\(^{-3}\) ± 1 x 10\(^{-4}\) |
| TiO2-EY-DCF          | 3 x 10\(^{-3}\) ± 1 x 10\(^{-4}\) | 5 x 10\(^{-3}\) ± 3 x 10\(^{-4}\) | 4 x 10\(^{-3}\) ± 2 x 10\(^{-4}\) |

Fig. 6. Experimental scheme of the reactive system.
Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dib.2019.104370.

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