Decoloration and degradation of erythrosine by gamma irradiation

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AMIRA ZAOUAK ; JELASSI HAIKEL

Laboratoire de Recherche Energie et Matière pour le Développement des Sciences Nucléaires & Direction de la Recherche sur l'Energie et la Matière, National Centre for Nuclear Sciences and Technologies, Sidi Thabet Technopark 2020 Ariana Tunisia

- *The possibility of using gamma-rays to degrade and decolorize a food colorant in water has been investigated in this study.*
- *Erythrosine aqueous solutions were irradiated with doses from 0.1 kGy to 10.0 kGy at 47.63 Gy/mn dose rate.*
- *The change in absorption spectra, the chemical oxygen demand (COD), the total organic carbon (TOC) and kinetic of degradation were examined.*

1. Erythrosoine

Erythrosine is an organoiodine compound, specifically a derivative of fluorone. It is cherry-pink synthetic dye and primarily used for food coloring. The erythrosine is one of the most widely used dyes in the food industry, which is also used as an additive in pharmaceutical tablets and capsules. However, this highly toxic xanthene class of dye is carcinogenic, and can lead to reproductive, developmental, neuronal and acute toxicity and provoke tumors at the site of application .

Thus, the removal of erythrosine from water and wastewater is a need of the highest order.

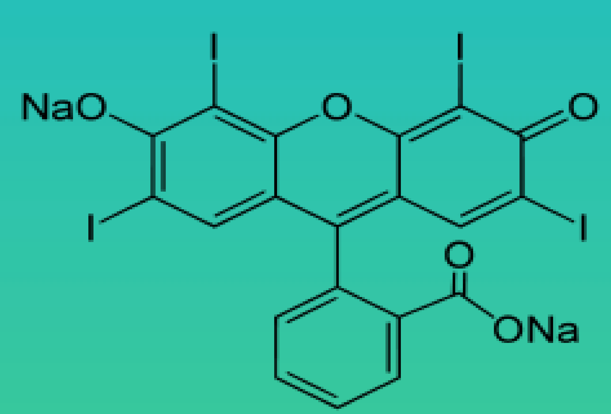

Fig. 1. *Structural chemical formula of erythrosine dye*

2. Gamma irradiation

The irradiation of the samples with γ-radiation was carried out using the Cobalt 60 radiation source. The gamma irradiation of dilute aqueous solutions results principally in ionization of water molecules and product several reactive species including hydroxyl radicals, solvated or hydrated electrons, hydrogen atoms, hydronium ions…

$$H_2O \xrightarrow{\gamma} OH^\bullet + H^\bullet + H_3O^+ + e^-_{aq}$$

The OH radicals are highly reactive species, able to act rapidly and non-selectively on the organic material. They cause its transformation to a biodegradable material.

3. UV- Visible Spectrophotometric analysis

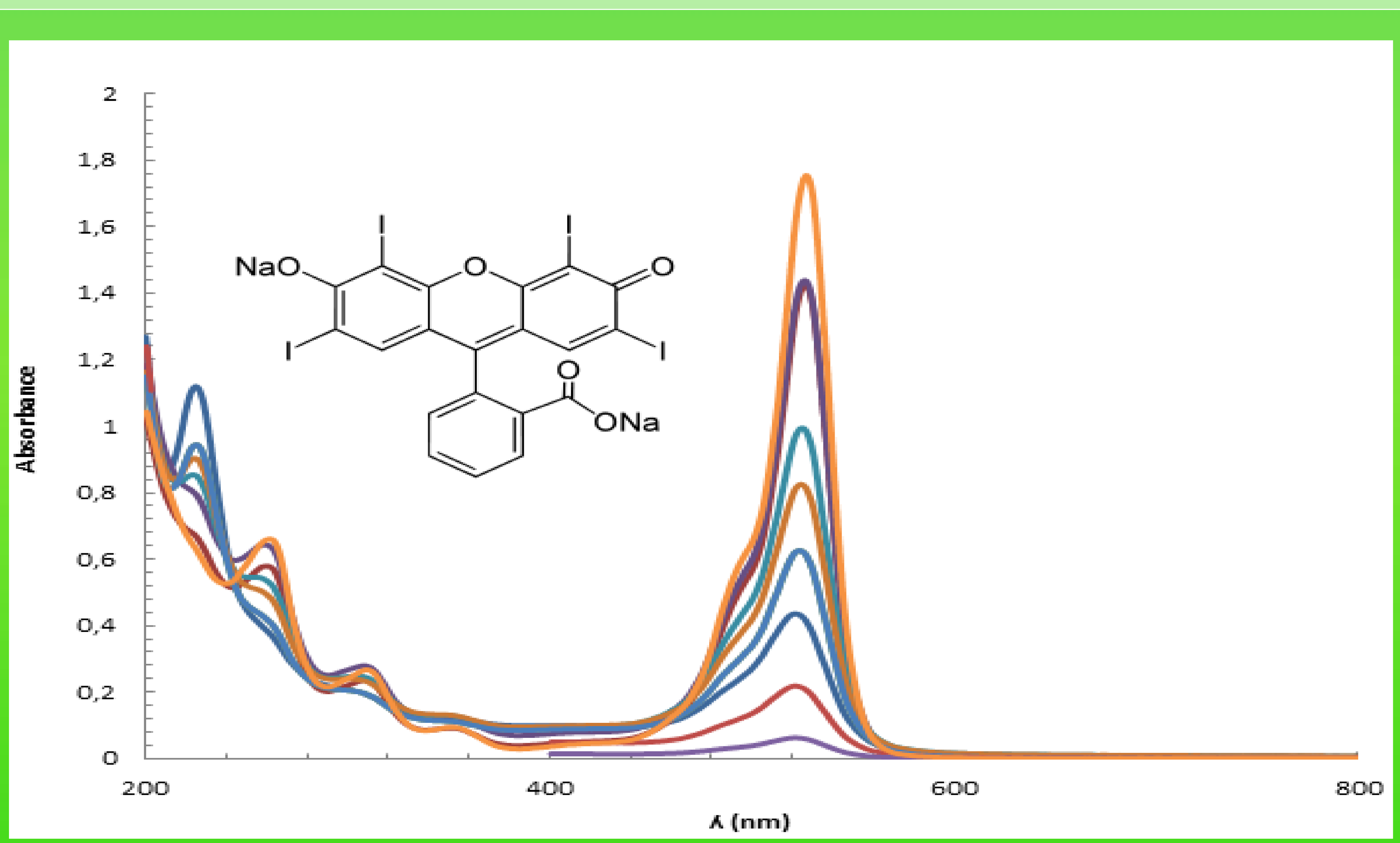

Fig. 2. *Absorption spectra of unirradiated and irradiated erythrosine(150 mg/L) aqueous solutions at different doses (from 1 to 10 kGy)*

- **Before treatment:** Presence of three bands located in the UV region (**λ**=315, 265 and 225 nm**)** and a single peak located in the visible region (λ=528 nm).
- **After treatment:** for all bands, absorbance decreases with increasing irradiation dose. The absorption peak at 528 nm decrease rapidly and disappear completely at 10 kGy indicated the reduction of chromophomic group

4. Kinetic study

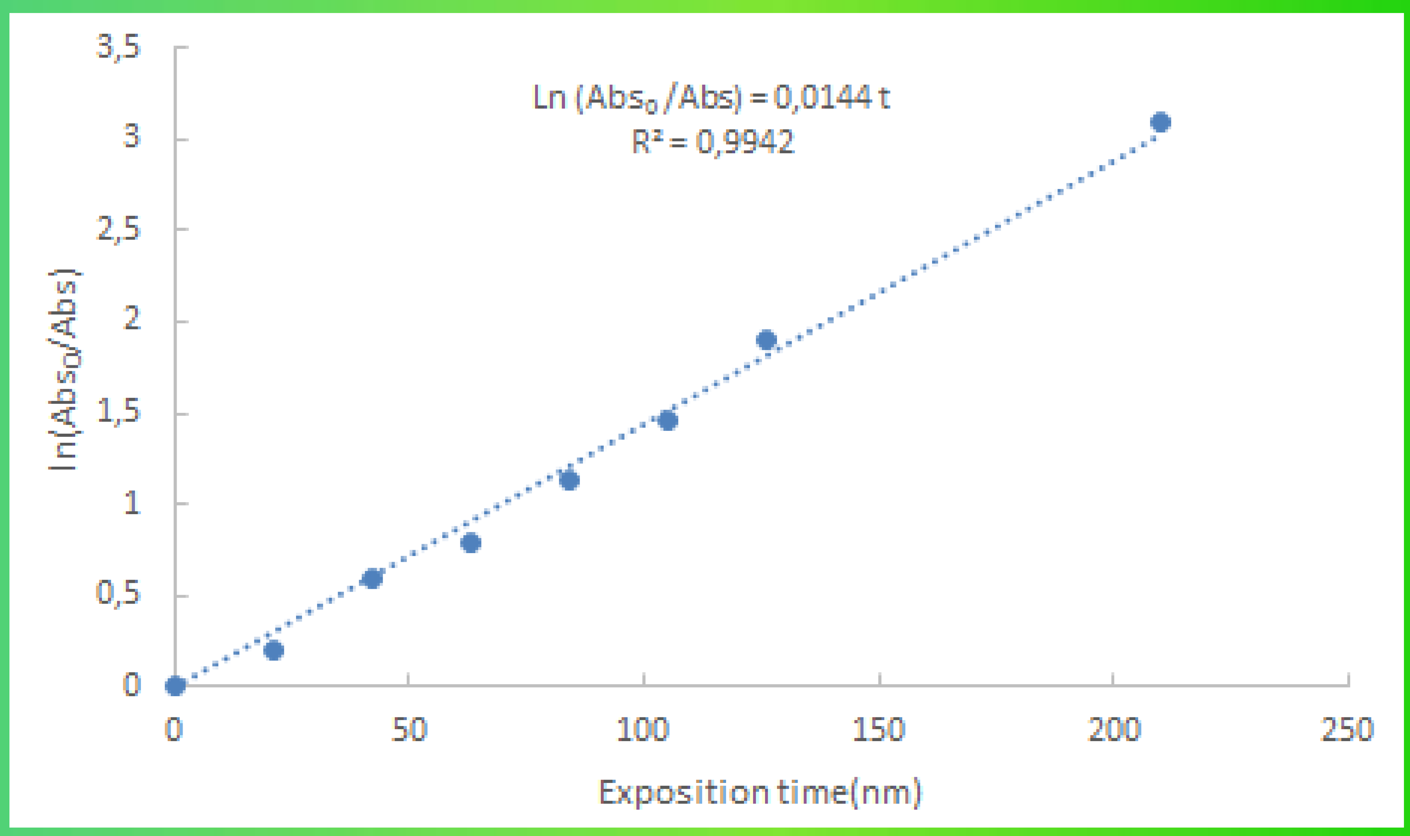

Fig. 3. *The graph presenting ln(Abs$_0$ /Abs)=f(t)of aqueous solution of erythrosine (150 mg/L)*

A linear variation indicating a pseudo first order degradation of erythrosine with ***K_{app}= 0,0144 min^{-1}***

5. COD Analysis

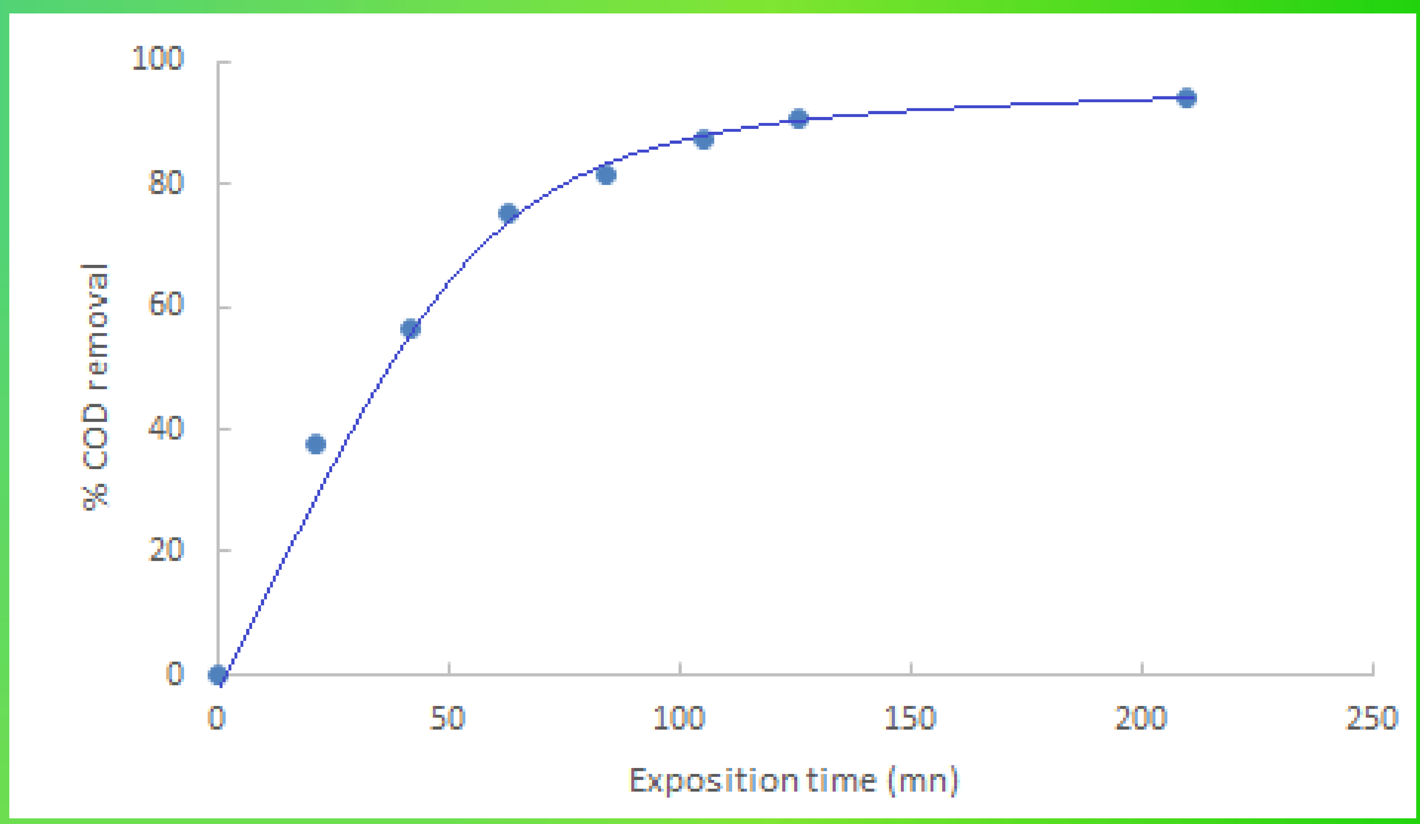

Fig. 4. *% COD removal of aqueous solution of erythrosine (150 mg /L) at different doses.*

The COD reduction for the dye solutions was 95% at 10 kGy

6. TOC Analysis

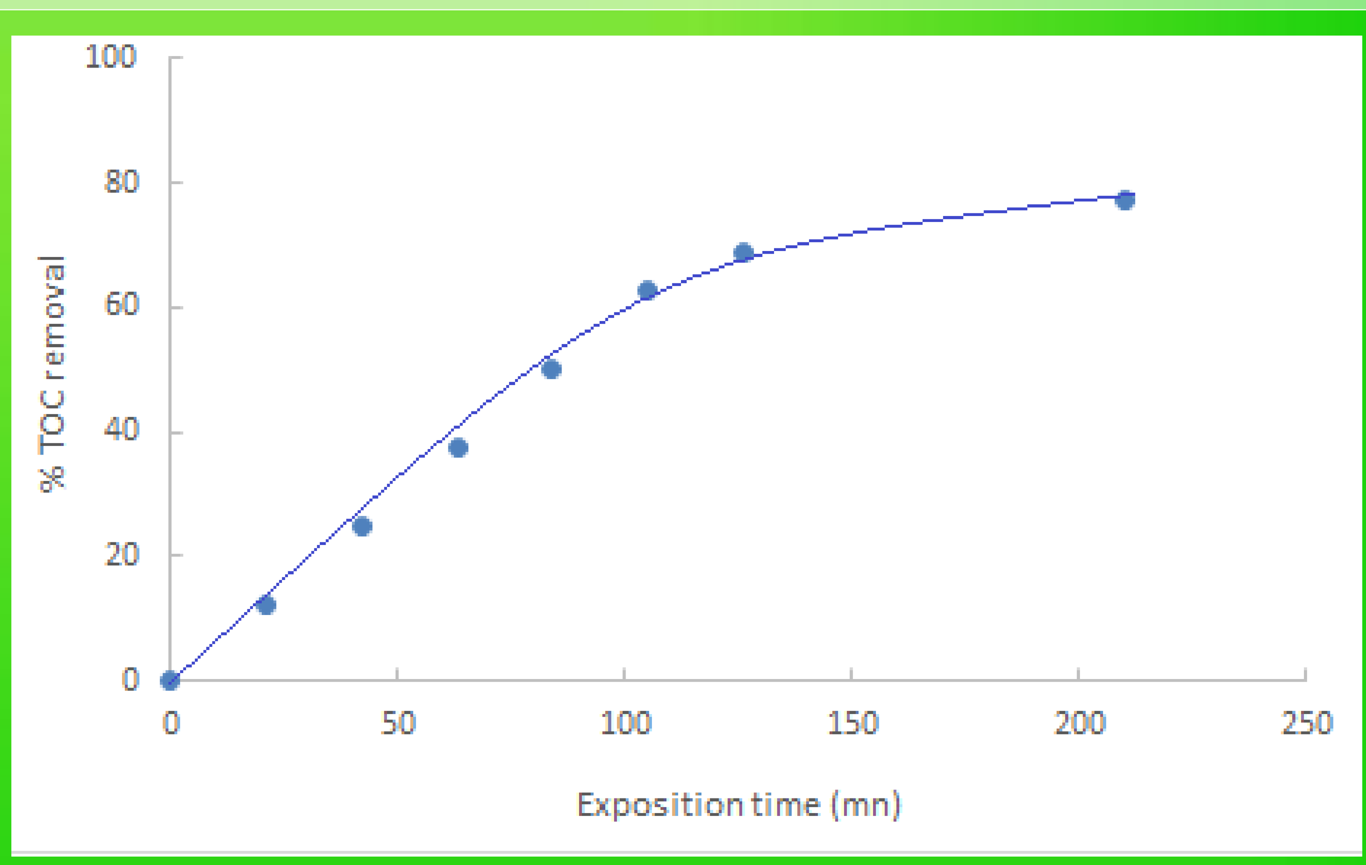

Fig. 5. *% TOC removal of aqueous solution of erythrosine (150 mg /L) at different doses.*

The TOC reduction for the dye solutions was 80% at 10 kGy

In conclusion, radiation processing has been considered as a promising process for the treatment of food dye erythrosine.