Indigoidines as products of citrazinic acid photodegradation

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Citrazinic acid (CZA) is a heteroaromatic carboxylic acid formed by condensation reactions of citric acid (CA) with ammonia or urea. Therefore, CZA and its derivatives are also found in carbon dots (CDs) synthesized from these precursors [1]. Recently, it has been shown that phototreatment of CDs prepared from CA and urea leads to significant changes in colour – the originally colourless solution turns first blue and then red. Interestingly, phototreated CDs have an increased photocatalytic activity for the hydrogen evolution reaction. Analogous colour changes as well as partial photocatalytic activity is also observed for irradiated solutions of CZA [2], [3].

From the structural point of view, this change is generally attributed to the formation of indigoidines, blue pigments with heterocyclic structure that are produced by many bacteria by metabolic transformations of glutamic acid (the same products are also formed when CZA is used as a growth medium). However, although the exact structure of bacterial indigoidines is known (for the two most common types, R_1 = OH or NH_2, R_2 = H, see Figure 1), the exact structure of CZA photoproducts has not yet been resolved.

In this work, we synthesized the two most common indigoidine derivatives and compared their UV-VIS spectra with those of the photodegradation products formed from CZA. Although these compounds exhibit absorption within similar spectral regions, their absorption maxima do not match those of the CZA photoproducts. Consequently, their exact structure could not be conclusively identified based on spectral data alone. However, our results demonstrate that the two most common indigoidine derivatives are probably not among the photodegradation products of CZA.

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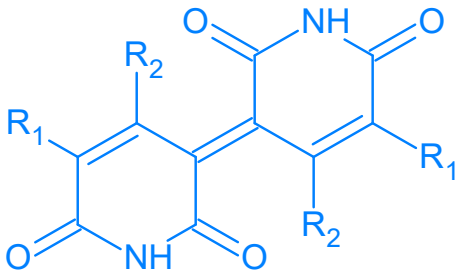

Figure 1 – General structure of indigoidine derivatives possibly formed by photodegradation of CZA. R_1 = OH or NH_2, R_2 = H or COOH

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