CARBON NANODOTS AS NANOCARRIER FOR DELIVERY OF SQUARAINES: AN *IN VITRO* EVALUATION TO INVESTIGATE THEIR PHOTODYNAMIC ACTIVITY

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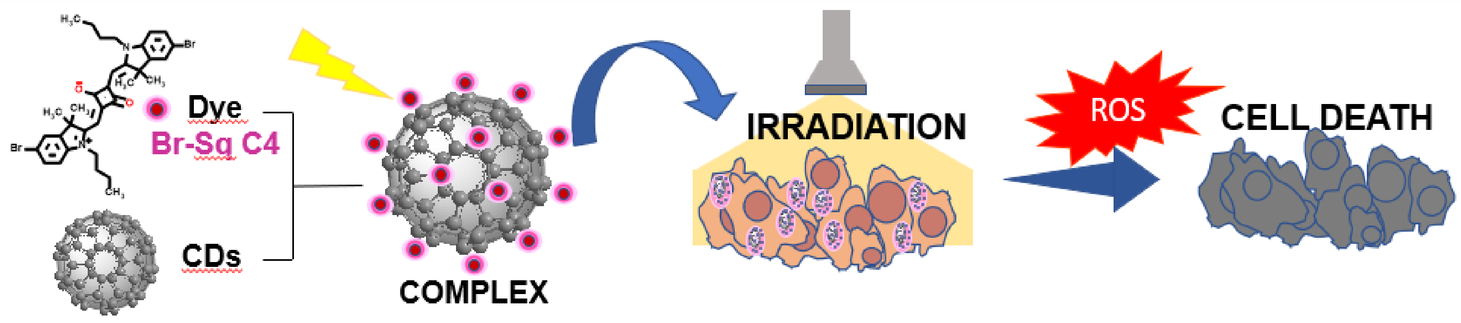
STATE OF THE ART

Carbon Dots (CDs) are an emerging fluorescent class of carbon-based nanoparticles, characterized by outstanding optical properties, aqueous solubility, biocompatibility and low toxicity. Owing to the easiness to synthesize them from green materials and to functionalize their surface, CDs have increasingly attracted considerable attention in many different fields, including drug delivery and photodynamic therapy (PDT) [1].

PDT is a non-invasive approach for cancer treatment, based on the specific irradiation of a photosensitizer (PS), previously systemic or locally administered, in order to generate reactive oxygen species (ROS), causing cancer cell death [2]. Over the course of the last few years, extensive research efforts have been devoted to the development of near-infrared (NIR) dyes for biological applications, particularly for PDT. Among polymethine dyes, Squaraines deserve to be defined as innovative potential photosensitizers (PSs) because of their high molar extinction coefficients and tunable absorption wavelengths, typically in NIR region, perfectly matching the phototherapeutic window (600-900 nm). However, their chemical instability and self-aggregation properties, in physiological conditions limit their extensive use. To overcome these disadvantages, the incorporation into biocompatible nanoparticles can prevent the formation of dye aggregates in aqueous environment and protect the physicochemical properties.

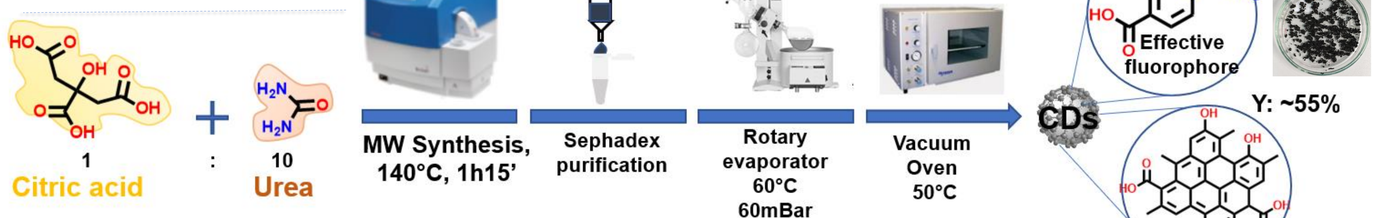
PURPOSE

- Increasing the biocompatibility and the aqueous solubility of a photodynamic active squaraine (Br-Sq-C4), without altering its properties.
- Evaluating the photodynamic activity of Br-Sq-C4 trough *in vitro* PDT tests



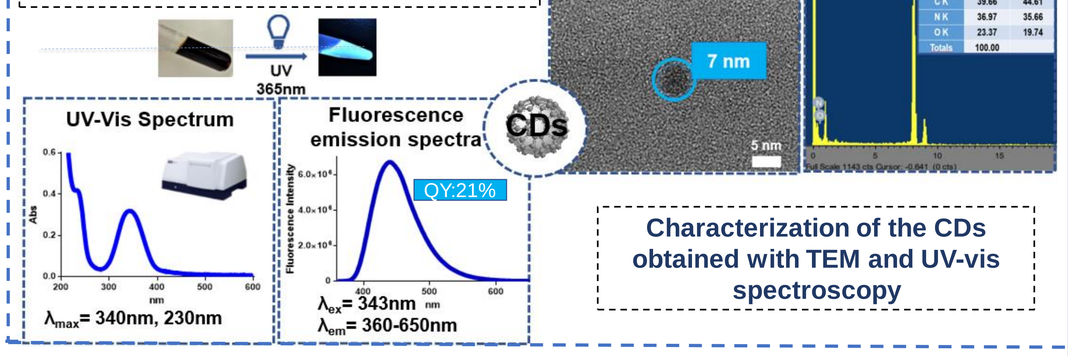
EXPERIMENTAL PART

CDs SYNTHESIS



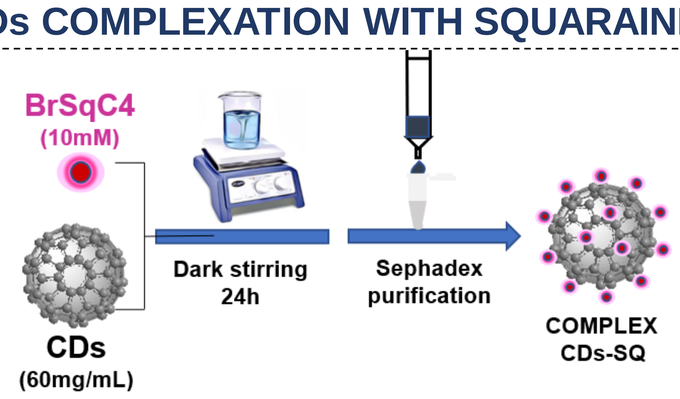
A bottom-up microwave-based synthesis approach has been used

CDs CHARACTERIZATION

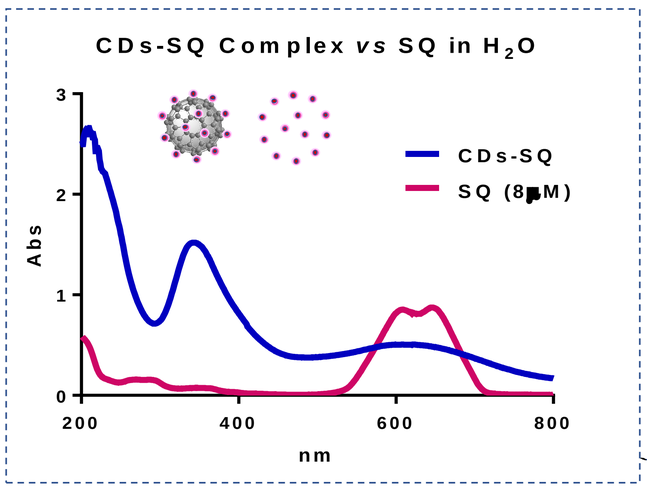


Characterization of the CDs obtained with TEM and UV-vis spectroscopy

CDs COMPLEXATION WITH SQUARAINE



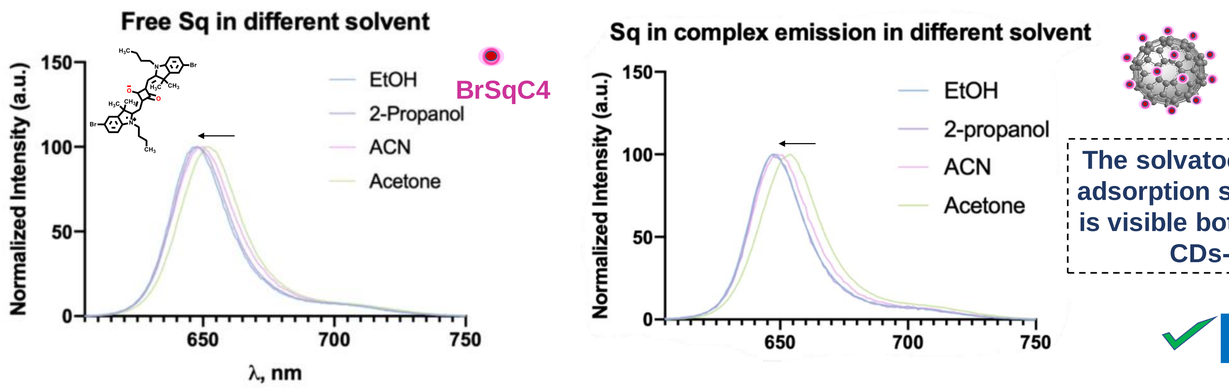
QUANTIFICATION OF SQ in CDs-SQ COMPLEX



2,26μM
of Br-sq-C4 in 1 mg/mL

~ 1μM= Adequate concentration for MTS assay ~

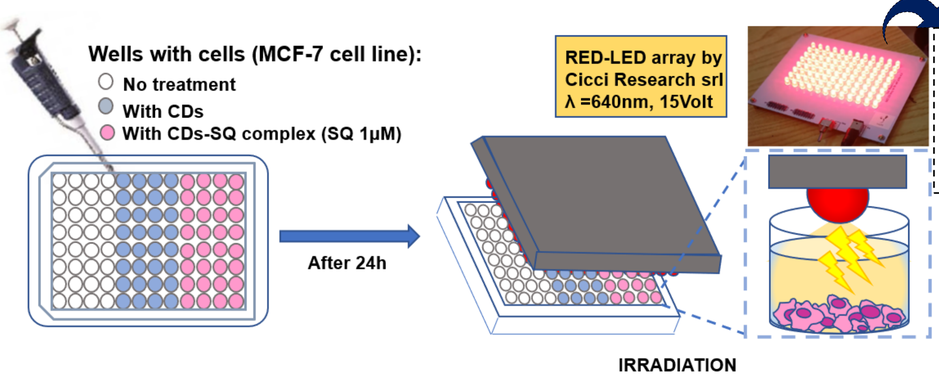
ENCAPSULATION OR PHYSICAL ADORPTION?



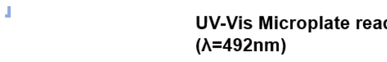
The solvatochromic shift of the adsorption spectrum of BrSQC4 is visible both, in free SQ and in CDs-SQ complex

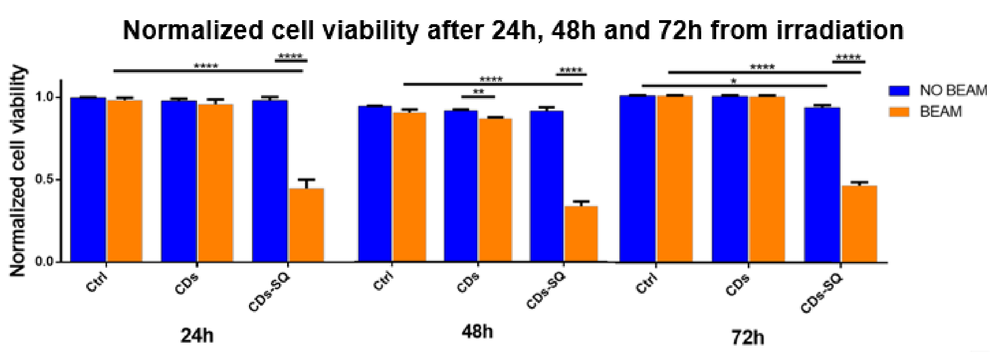
✓ ADSORPTION

IN VITRO EVALUATION OF CDs-SQ PHOTODYNAMIC ACTIVITY (MTS assay)



The photodynamic activity of CDs-SQ complexes was evaluated in terms of cell viability before and after 15 min of irradiation by using a compact LED array-based illumination system (96 LEDs in a 12*8 arrangement)





✓ CDs biocompatibility confirmed

ONGOING…

- CDs photodynamic activity
- CDs-SQ antimicrobial activity

TAKE HOME MESSAGE

- CDs synthesized trough green materials, presents higher fluorescence emission intensity and QY
- The Squaraine, Br-Sq-C4, complexed with CDs, shows a ↓ aggregation state in aqueous environment and ↑ emission fluorescence
- CDs-Br-SqC4 complex could be used for PDT
- The investigation on CDs-Sq antimicrobial properties is currently ongoing

ACKNOWLEDGEMENTS

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REFERENCES

[1] Y. Yuan et al., "Doxorubicin-loaded environmentally friendly carbon dots as a novel drug delivery system for nucleus targeted cancer therapy", Colloids Surfaces B Biointerfaces, 2017; 159: 349-359
[2] D. M. Dereje *et al*., *Polymethine dyes for PDT: recent advances and perspectives to drive future applications*, Photochemical & Photobiological Sciences, 2022; 21:397-419

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