

THE PREPARATION AND MODIFICATION OF THE BIOMASS-DERIVED CARBON QUANTUM DOTS – Investigating their Potential in Biomedical and Pharmacological Application

PhD Student: Silvija Šafranko, mag.chem. Project Principal Investigator: Stela Jokić, full professor



Carbon nanomaterials – Relevance

02



Carbon Quantum Dots – CQDs (1)



Carbon Quantum Dots – CQDs (2)



Carbon Dots: A Mystic Star in the World of Nanoscience

Why are carbon quantum dots important and special?



*PL-Photoluminescence

() 5

CQDs Characterization









STRUCTURAL AND CHEMICAL CHARACTERIZATION





OPTICAL CHARACTERIZATION

Biomass-derived CQDs

CAN WE USE BIOMASS FOR THE CQDs PREPARATION?



Potential Application of CQDs – Highlighted Works (1)



Cellular imaging of tumor cells

Metal ions and (bio)molecules detection





chlighted Works (2)

Review An Overview of the Recent Developments in Carbon Ouantum **Dots**—**Promising**

U: Neke mogućnosti iskorištenja nusproizvoda prehrambene industrije - Knjiga 3.

ISBN: 978-953-7005-75-7

Silvija Šafranko ¹, Dominik G Tihomir Moslavac¹, Igor Jerkovi

(Bio)Molecule Ser

Urednici: Drago Šubarić Borislav Miličević

©2021 Sveučilište Josipa Jurja Strossmayera u Osijeku, Prehrambeno-tehnološki fakultet Osijek, Veleučilište u Požegi



al Application for



parathion, chemet, SF

Biosensing

Our Preliminary Results in CQDs Research (1)



The prepared CQDs exhibited good biocompatibility, stability in aqueous and high ionic strength media, similar optical properties, while differences were observed regarding the structural and chemical diversity, biological and antioxidant activity.

Our Preliminary Results in CQDs Research (2)



Our Preliminary Results in CQDs Research (3)



Antiradical activity

Pure CQD<CQDs@Gly<CQDs@Arg

Sample	Cell line IC ₅₀ (µg/mL) ¹					
	HepG2	CFPAC-1	MCF-7	HCT-116	HFF-1	
Pure CQD	>100	>100	>100	>100	1 st experiment	20.59 ± 0.02
					2 nd experiment	1.50 ± 0.02
					3 rd experiment	>100
CQD@Arg	>100	>100	>100	>100	1 st experiment	7.85 ± 0.02
					2 nd experiment	Proliferative effect
					3 rd experiment	>100
CQD@Gly	>100	6.91 ± 0.81	>100	>100	1 st experiment	0.46 ± 0.01
					2 nd experiment	Proliferative effect
					3 rd experiment	>100

Table 1. Antitumoractivity and cell viability

Specific antitumor activity – CFPAC-1 cells (CQDs@Gly)

Our Preliminary Results in CQDs Research (4) coD@Arg

013





Cellular imaging

Our Preliminary Results in CQDs Research (5)

014



POTENTIAL APPLICATIONS

BIOMASS CAN BE USED AS A CARBON SOURCE FOR CQDs PREPARATION

Šafranko, S.; Stanković, A.; Hajra, S.; Kim, H.-J.; Strelec, I.; Dutour-Sikirić, M.; Weber, I.; Bosnar, M.H.; Grbčić, P.; Pavelić, S.K.; Széchenyi, A.; Mishra, Y.K.; Jerković, I.; Jokić, S. Preparation of Multifunctional N-Doped Carbon Quantum Dots from *Citrus clementina* Peel: Investigating Targeted Pharmacological Activities and the Potential Application for Fe³⁺ Sensing. *Pharmaceuticals* **2021**, *14*, 857. https://doi.org/10.3390/ph14090857

Further investigation will include...

015



HETEROATOM DOPING AND SURFACE FUNCTIONALIZATION

Investigation of chemical composition and surface complexity on the optical properties od prepared CQDs, as well as applicability

03

DEVELOPMENT OF ELECTROCHEMICAL SENSORS

Electrode coating with different CQDs nanocomposite and detection of different ions and (bio)molecules; pesticides, application in food control, drug detection,...



PREPARATION OF NANOCOMPOSITES

Preparation of different nanocomposites and further investigation on the pharmacological and biological activity



TESTING PHOTOCATALYTICAL ACTIVITES

Due to their outstanding electronic properties, unique fluorescence behavior and photoelectron transfer properties.

Acknowledgements



Uni



BIOTEHNOLOGY UNIVERSITY OF RIJEKA



Institute of Pharmaceutical Technology and Biopharmacy



Daegu Gyeongbuk Institute of Science & Technology



This work has been supported by Croatian Science Foundation under the project "Application of innovative techniques of the extraction of bioactive compounds from by-products of plant origin" (UIP-2017-05-9909)

SCIENCET

THANK YOU FOR YOUR ATTENTION!