MY EXPERIENCES IN SCIENCE

ELIF TARAKCI

YEDİTEPE UNIVERSITY

YEDITEPE UNIVERSITY

09.2020 – 03.2023: *Master's Degree,*
Biomedical Engineering.

09.2015 - 01.2020: *Bachelor's degree,*
Biomedical Engineering.

UNIVERSITY HOSPITAL

FACULTY OF ENGINEERING

PRESENTATION FLOW

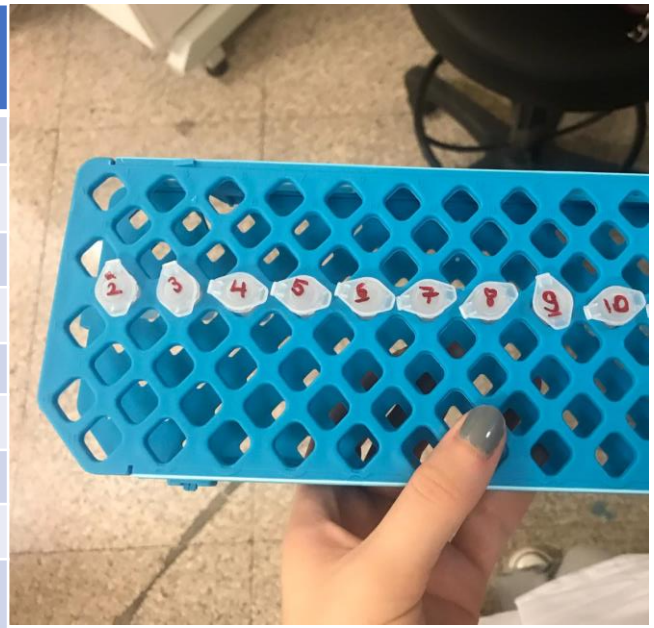
AIM

The main goal of this study was to prepare molecularly imprinted polymers (MIPs) with glucose recognition sites and to evaluate their glucose-binding properties for potential applications in glucose sensing.

This study maintained to understand the binding affinity of glucose to PAG with Open Circuit Voltage (OCV), Cyclic Voltammetry (CV), and Potential Electrochemical Impedance Spectroscopy (PEIS) measurements.

Imprinted with 0.2M, 0.4M, 0.6M and 0.8M Glucose

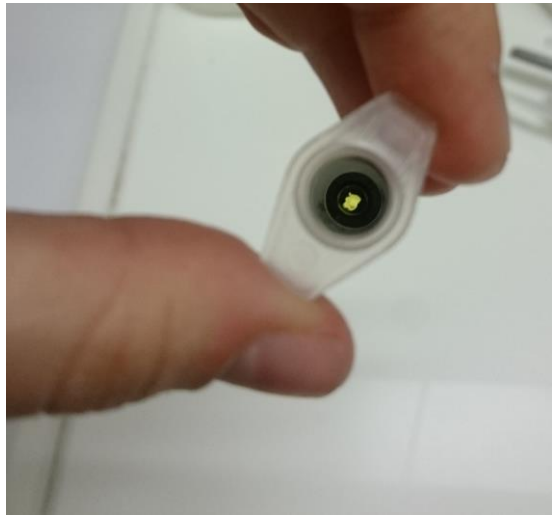
SOLUTION NUMBER	GLUCOSE CONCENTRATION
II	1.004×10^{-6} M
III	1.004×10^{-7} M
IV	1.004×10^{-8} M
V	1.004×10^{-9} M
VI	1.004×10^{-10} M
VII	1.004×10^{-11} M
VIII	1.004×10^{-12} M
IX	1.004×10^{-13} M
X	1.004×10^{-14} M



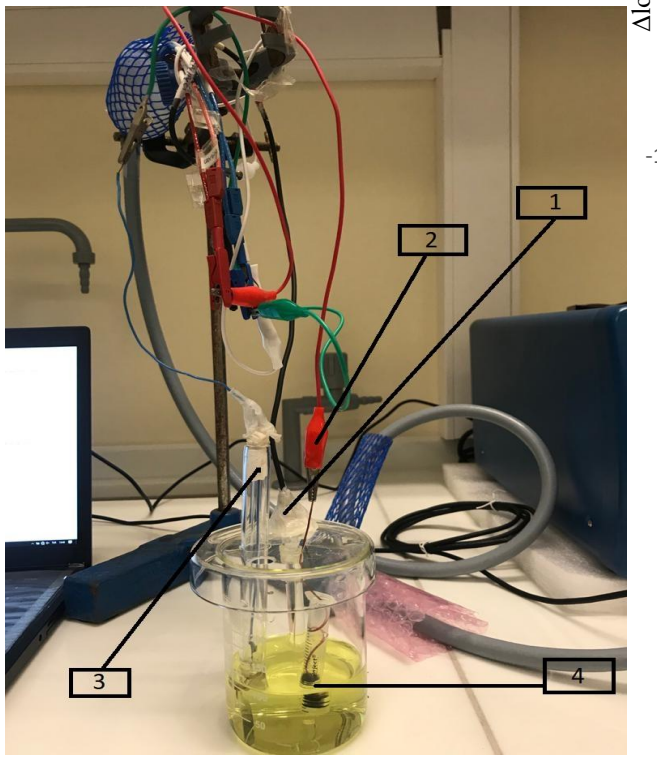
Average glucose in human sweat : 6×10^{-5} to 2×10^{-4} M

EXPERIMENTAL OUTCOMES

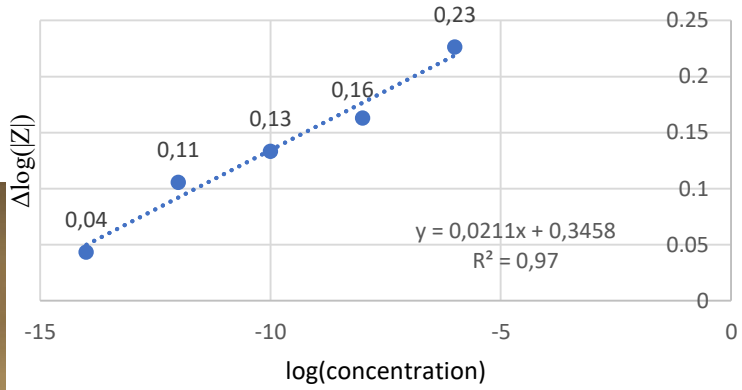
Graphics from 0.4M glucose-imprinted polyacrylamide gel yielded results similar to those observed at 0.2M. It was concluded that, 0.4 M glucose imprinted polyacrylamide gels were suitable for glucose detection. Artificial glucose receptor based on electrochemical analysis improved the LOD and LOQ by about 8 to 6 fold than without the MIP technology.



redox reaction in the potential range of -0.5 to 0.5 V



Modulus Difference in 0.4M Glucose



- 1- RE: AgCl with saturated KCl
- 2- WE: Enameled copper wire,
- 3- Counter Platin electrode, and
- 4- PAG.

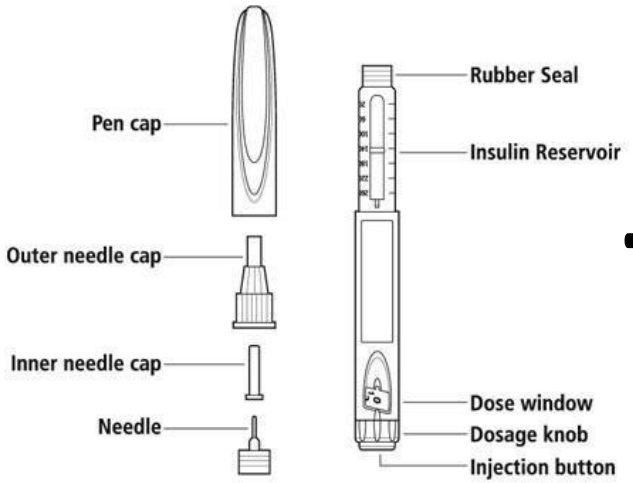
PRESENTATION FLOW

SIEMENS ITT PROJECT CONTEST : ORIGIN OF THE INSULIN PEN REDESIGN IDEA

WHY REDESIGNED INSULIN PEN?

- Reduces the risk of infection and skin damage caused by needle use through one-time needle use policy.
- Enables instant observation of remaining needle quantity with smart tracking technology.
- Optimizes storage space for used and non-used needles, streamlining healthcare facility organization.
- Incorporates a dedicated waste storage unit for safe disposal of used needles, ensuring safety and hygiene.
- Introduces a convenient and hygienic disposable rotating needle storage mechanism.
- Designed to be user-friendly, providing intuitive interfaces and ergonomic features for healthcare professionals.
- Emphasizes eco-friendly practices, using biodegradable materials and sustainability-focused design.
- Continuous improvement to meet evolving healthcare needs and technological advancements.

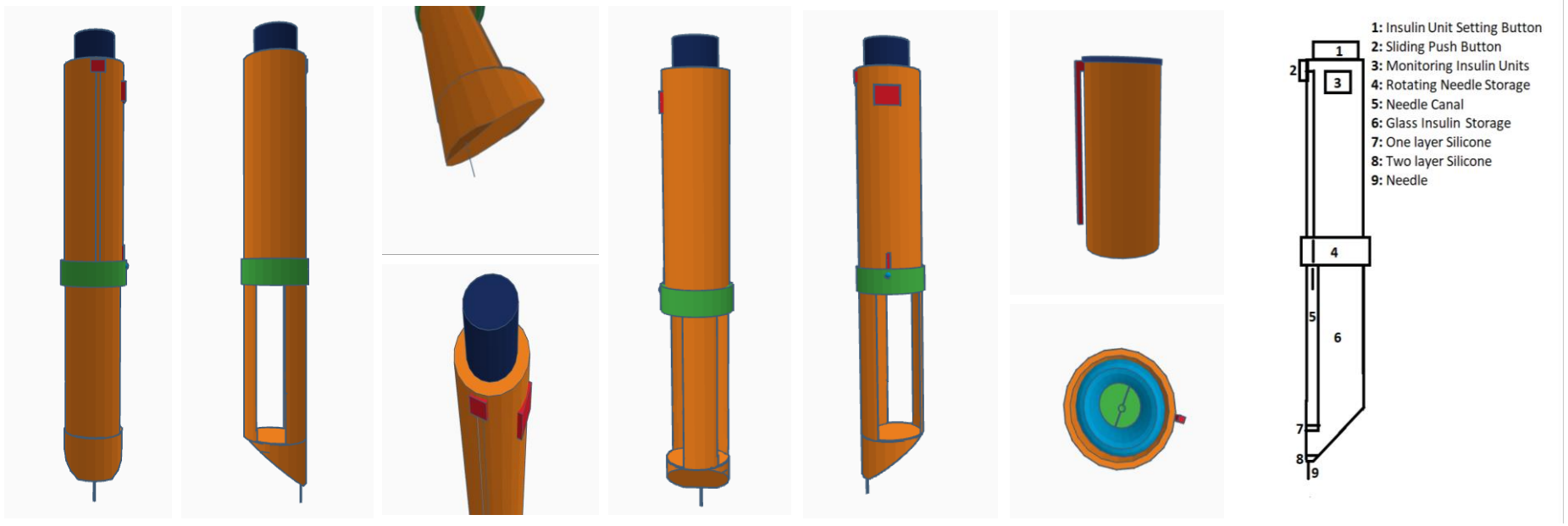
CONVENTIONAL INSULIN PEN + **STANDARD MULTIPLE PEN** + **REVOLVER CYLINDER** =



INSULIN PEN WITH LOADED NEEDLES

ELİF TARAKCI, AHMET BERTUĞ ERTEM, KÜBRA KIDIK, BIOMEDICAL ENGINEERING, T.C. YEDITEPE UNIVERSITY

INSULIN PEN WITH LOADED NEEDLES DESIGN



PRESENTATION FLOW

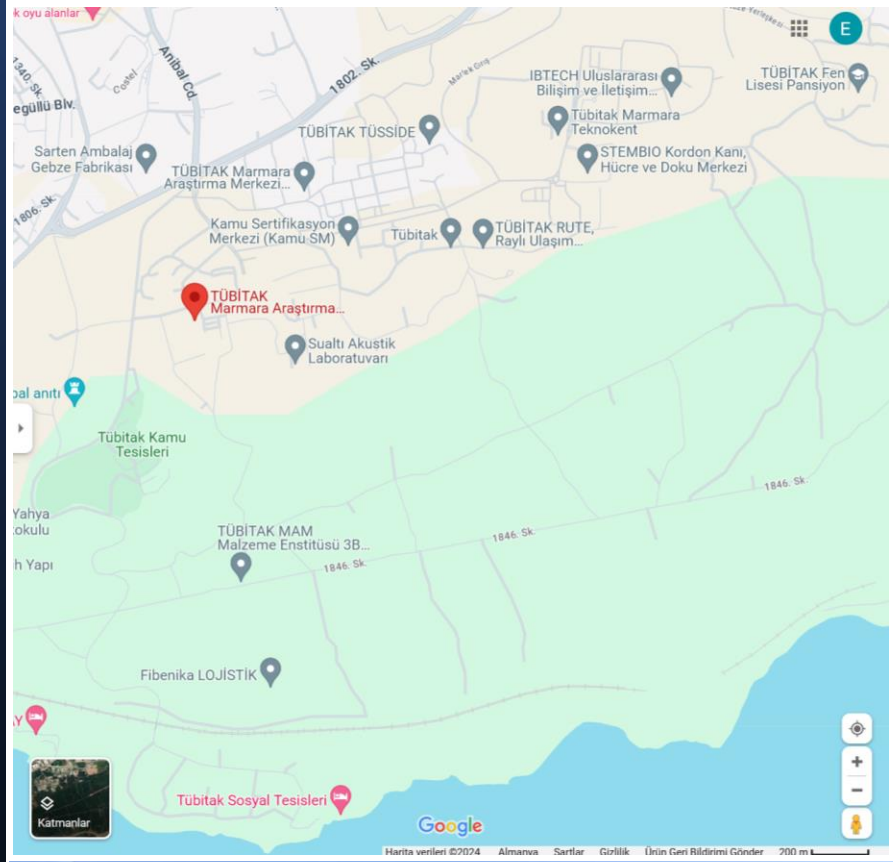
TÜBİTAK

MAM

TUBITAK MARMARA RESEARCH CENTER

10.2020 – 03.2023:

Research Assistant



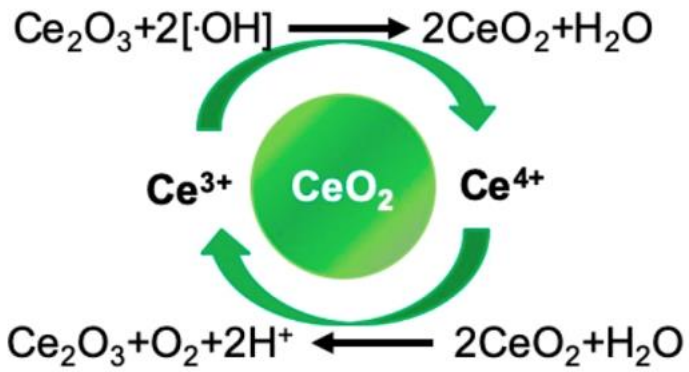
MEDICAL BIOTECHNOLOGY CENTER OF EXCELLENCE

VACCINE AND DRUG DEVELOPMENT CAMPUS

CERIUM OXIDE NANOPARTICLE (NANOCERIA)

One of the key features of cerium oxide nanoparticles is their ability to exhibit both antioxidant and pro-oxidant activities. These nanoparticles can act as scavengers of reactive oxygen species (ROS), which are implicated in various diseases, including cancer. By neutralizing ROS, cerium oxide nanoparticles may help protect cells from oxidative stress, a factor associated with cancer development.

* Nanoceria acting as an ion scavenger is based on the transition between +3 and +4 oxidation levels, which allows it to be toxic to tumor cells and non-toxic to stromal cells due to pH differences of microenvironment of the cells.



Naha PC, Hsu JC, Kim J, Shah S, Bouché M, Si-Mohamed S, Rosario-Berrios DN, Douek P, Hajfathalian M, Yasini P, Singh S. Dextran-coated cerium oxide nanoparticles: a computed tomography contrast agent for imaging the gastrointestinal tract and inflammatory bowel disease. ACS nano. 2020 Jul 21;14(8):10187-97.

SYNTHESIS STRATEGY AND FUNCTIONALIZATION OF NANOCERIA

Types of Synthesis Methods

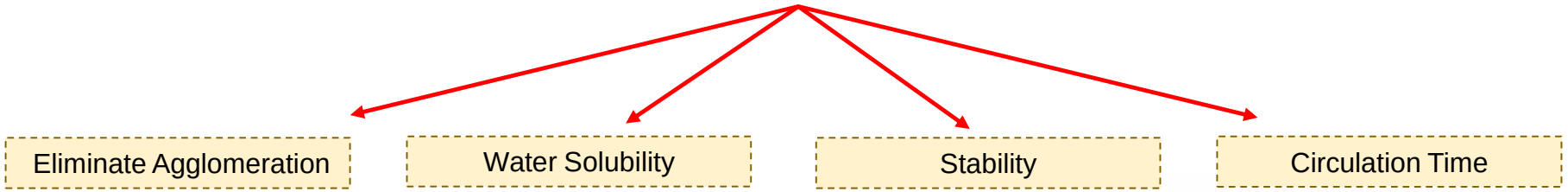
Green Synthesis Method

- Consist of sugars, plant extracts, microorganisms and biodegradable polymers
- Includes fungi-mediated and plant-mediated methods

Traditional Synthesis Method

- Includes sol-gel, solvothermal, hydrothermal, **precipitation** methods
- Spherical, cubic, polyhedral morphological structures (depends synthesis method)

Main Reasons of Functionalization of Nanoceria

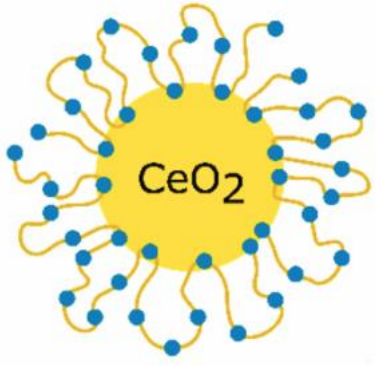


PEG

Chitosan

Dextran

Heparin

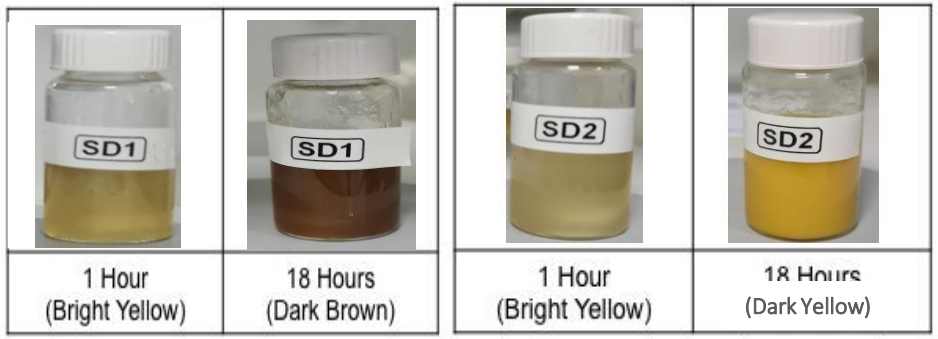


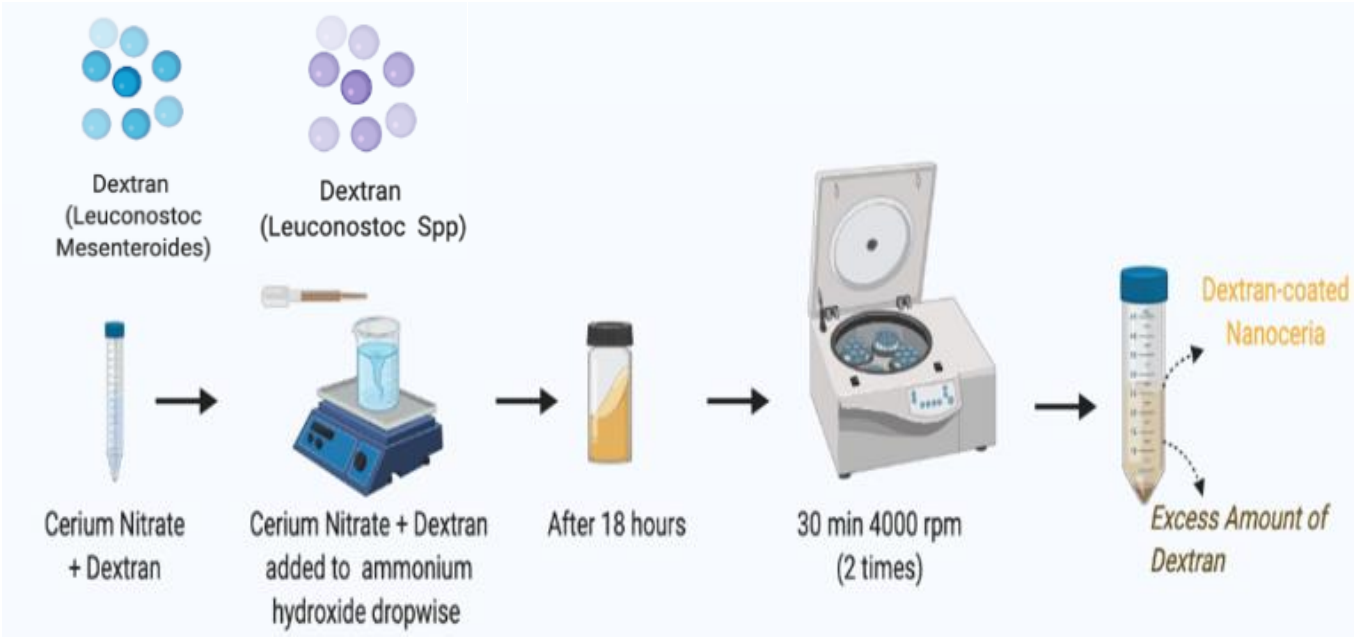
Naha PC, Hsu JC, Kim J, Shah S, Bouché M, Si-Mohamed S, Rosario-Berrios DN, Douek P, Hajfathalian M, Yasini P, Singh S. Dextran-coated cerium oxide nanoparticles: a computed tomography contrast agent for imaging the gastrointestinal tract and inflammatory bowel disease. ACS nano. 2020 Jul 21;14(8):10187-97.

SYNTHESIS AND CHARACTERIZATION OF DEXTRAN-COATED NANOCERIA (DEX-CENP)

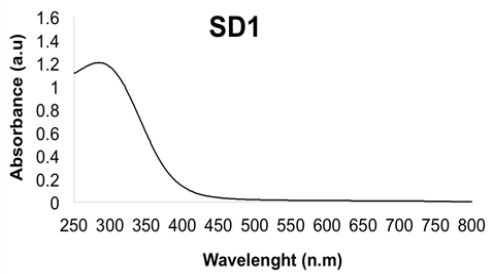
Synthesis & Characterization of Dextran-Coated Nanoceria

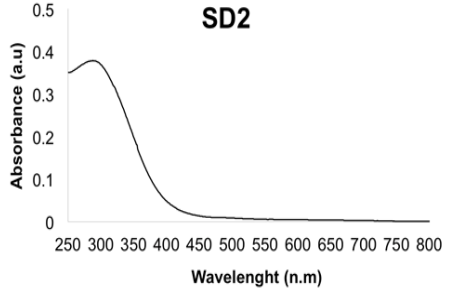
- Two types of Synthesis (SD1 and SD2)
- Dynamic Light Scattering (DLS)
- UV-Visible Spectrophotometry
- Fourier-transform Infrared (FTIR) Spectroscopy
- X-Ray Diffraction (XRD)
- Transmission Electron Microscopy (TEM)
- X-Ray Photoelectron Spectroscopy (XPS)
- Thermal Analysis (TG/DTA)
- Raman Spectroscopy
- Stability of Synthesized Dextran-Coated Nanoceria
- Determination of Concentration





Two different types of Dex-CeNPs were synthesized according to modified protocol published from Alparslan et al. with Dextran from Leunostoc Mesentoroides (Sigma Aldrich, Cat#D9260), Leuconostoc spp, (Sigma Cat#31388). Following nanoparticle synthesis, several characterization experiments held.

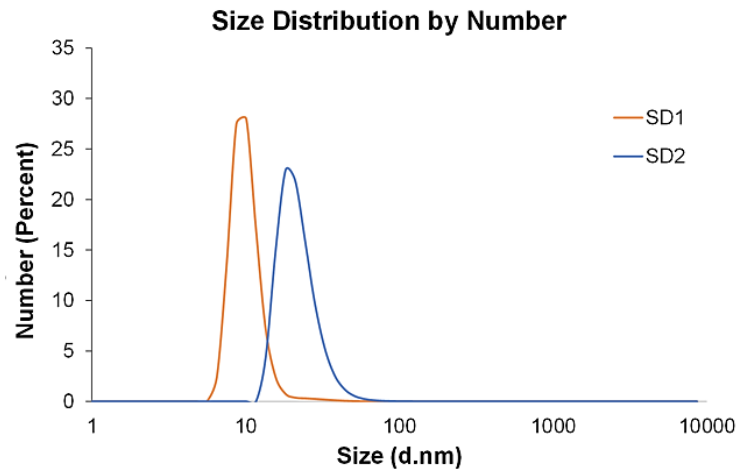




(1) Alpaslan E, Yazici H, Golshan NH, Ziemer KS, Webster TJ. PH-Dependent Activity of Dextran-Coated Cerium Oxide Nanoparticles on Prohibiting Osteosarcoma Cell Proliferation. ACS Biomater Sci Eng. 2015;1(11):1096–103.

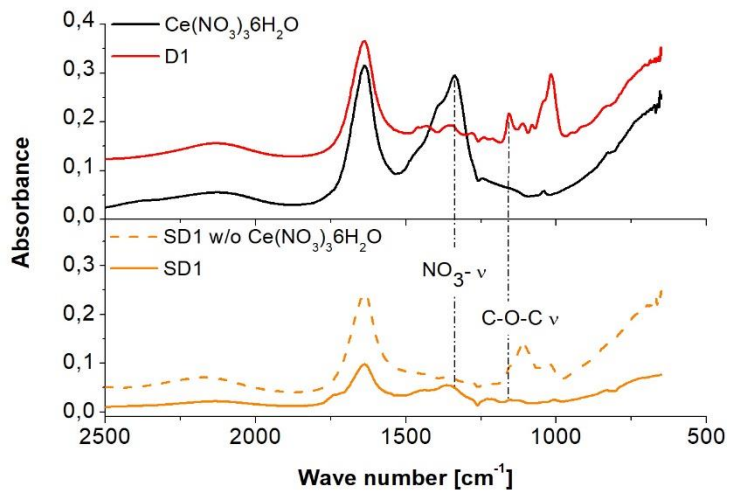
DLS & FTIR SPECTRUM OF DEXTRAN-COATED NANOCERIA SYNTHESIS

A

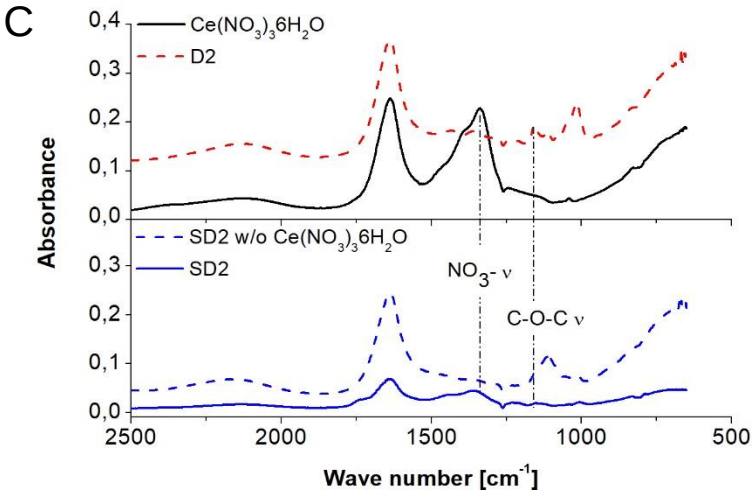


- SD1 has a particle size of approximately **10 nm**.
- SD2 has a particle size of approximately **30 nm.**

B



C



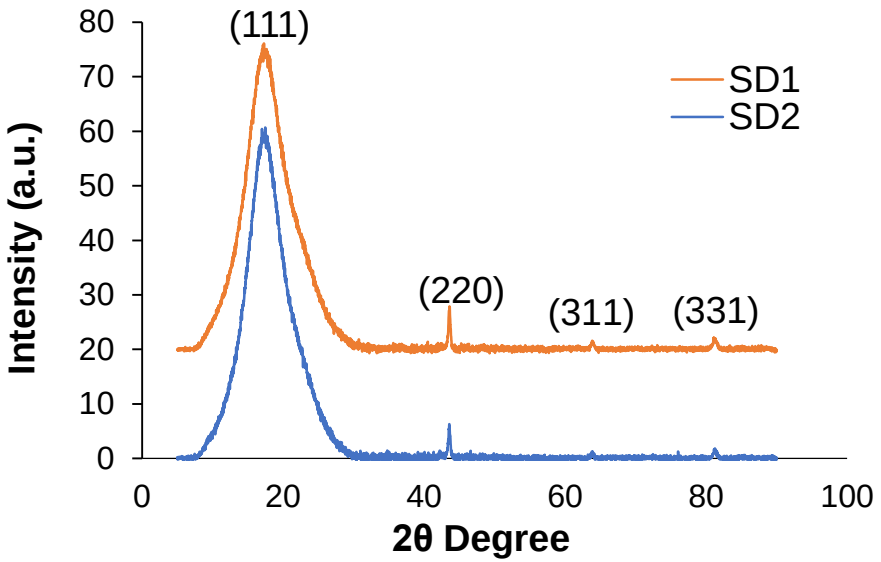
Dynamic Light Scattering analysis of Dextran-coated Nanoceria (A) Fourier-transform infrared spectroscopy analysis of Dextran-coated Nanoceria B) SD1, C) SD2.

Presence C-O-C Bonds shows the success bond in between dextran and nanoceria.

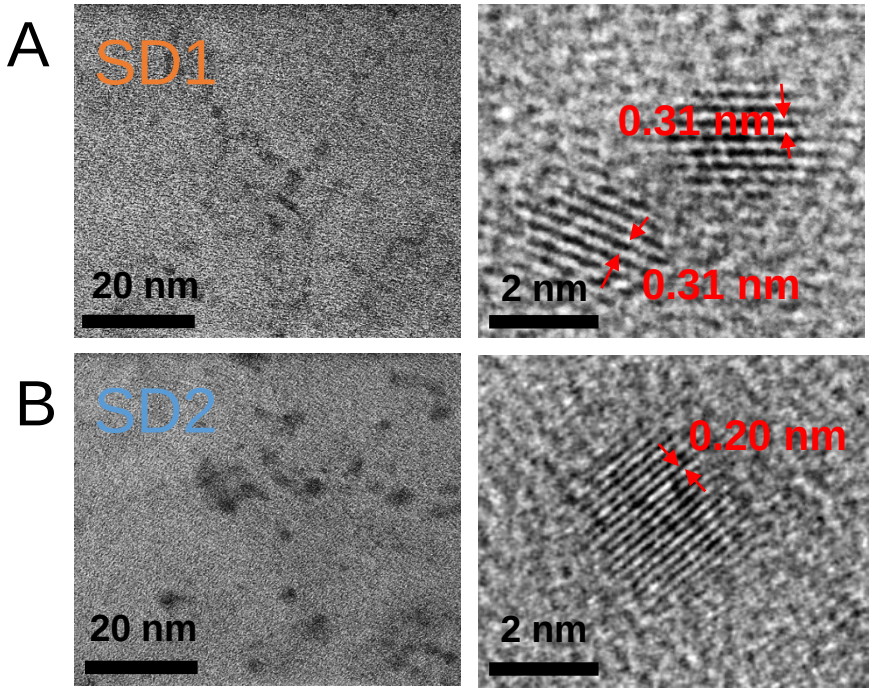
Both SD1 and SD2 is succesfuly surface coated with dextran.

Repeat : n^3

TEM OF DEXTRAN-COATED NANOCERIA SYNTHESIS



XRD measurements of SD1 and SD2.

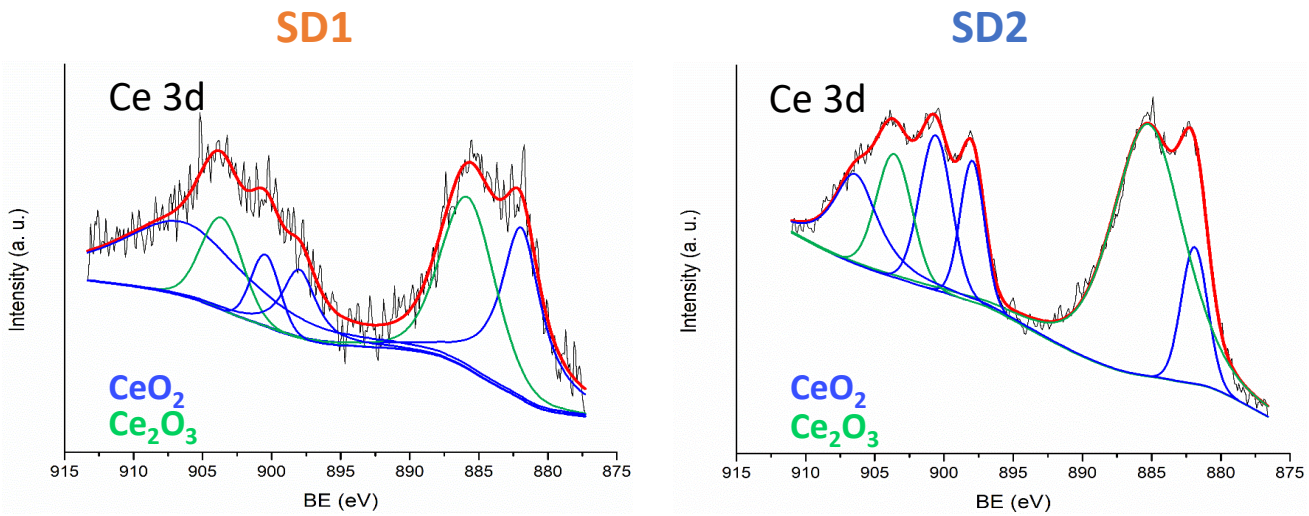


High Resolution Transmission Electron Microscopy (HRTEM) images of SD1 (A) and SD2 at 20 nm and 2 nm scales.

The XRD patterns of both SD1 and SD2 include several characteristic diffraction peaks of cerium oxide nanocrystals in Figure 1. The presence of (111), (220), (311), and (331) planes shows being a typical face-centered cubic (FCC) crystals. The XRD data is consistent with literature(1-4).

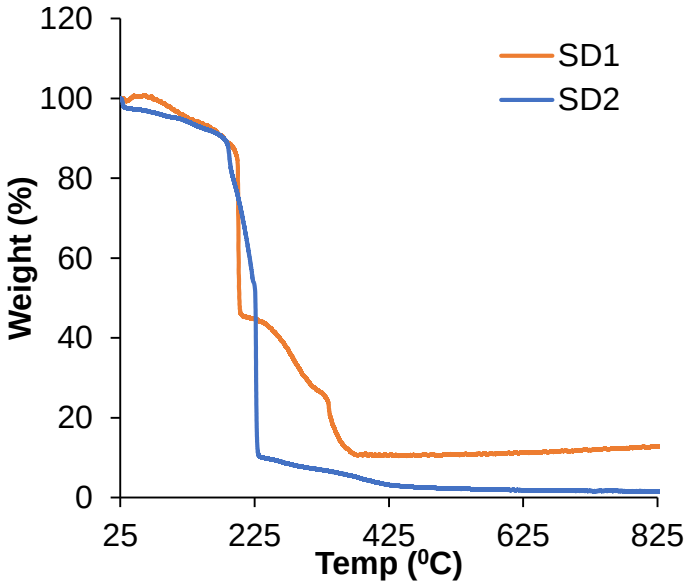
1) ACS Nano 2020, 14, 10187−10197 2) Scientific Reports, 2017, 7, 4636 3) Small 2008, 4, 552−556 4) Nanotechnology, 2005, 16, 1960

XPS & TGA ANALYSIS OF DEXTRAN-COATED NANOCERIA



XPS analysis of SD1 and SD2.

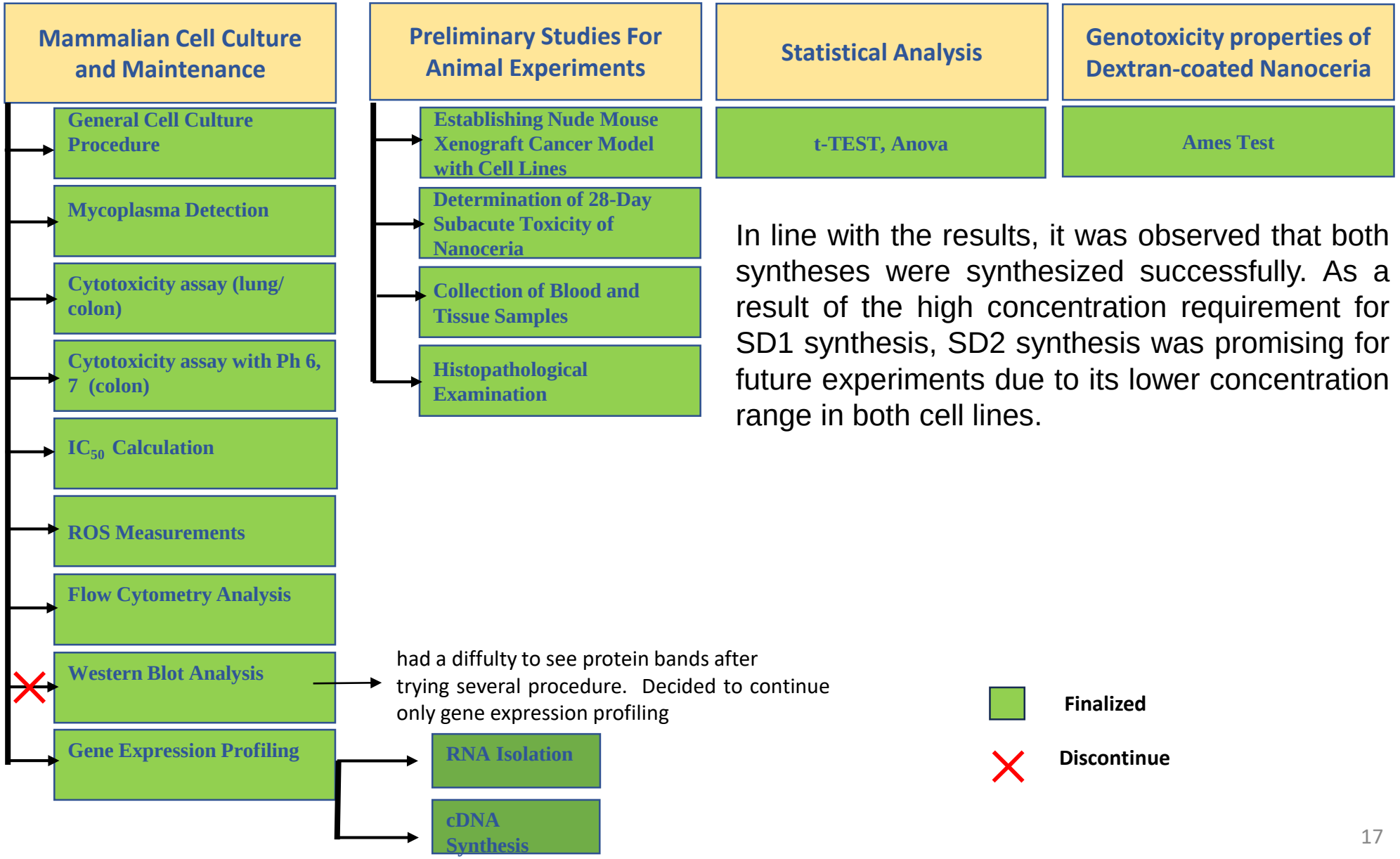
While both samples contained Ce^{3+} and Ce^{4+}, for the SD1 sample, the Ce^{4+} and Ce^{3+} content were calculated as 66.7% and 33.3%, respectively. On the other hand, for the SD2 sample Ce^{3+} content was 59.2% and Ce^{4+} content was 40.8%.



TGA plots of SD1 and SD2.

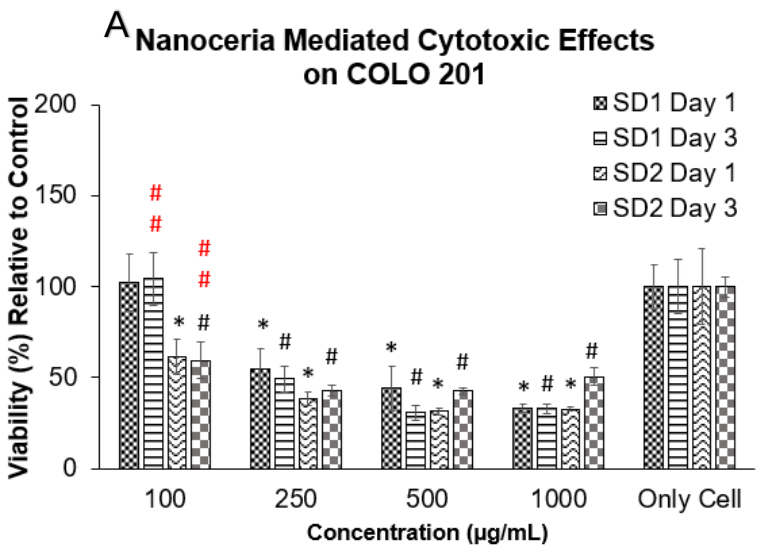
The initial weight loss of ~11% is observed between 25 and ~182 °C for both SD1 and SD2, corresponding to the removal of adsorbed water in the crystalline structure of cerium oxide. The total weight loss in SD1 is ~89.4% against ~96.7% for SD2 at 825 °C. This shows that SD2 is more stable on high temperature than SD1.

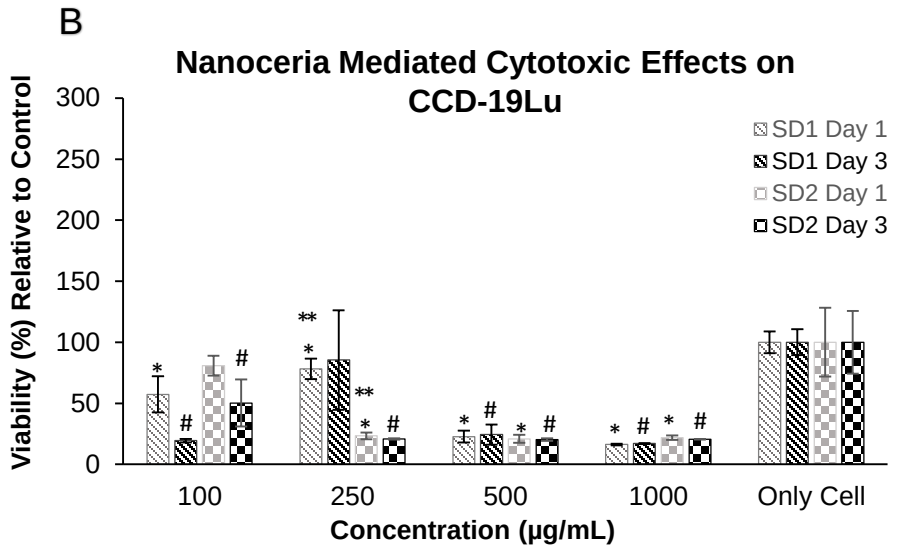
ICGEB PROJECT AND MASTER THESIS WORKFLOW



In line with the results, it was observed that both syntheses were synthesized successfully. As a result of the high concentration requirement for SD1 synthesis, SD2 synthesis was promising for future experiments due to its lower concentration range in both cell lines.

CYTOTOXICITY OF DEX-CENPS (SD1 AND SD2) AGAINST COLO 201 AND CCD-19Lu





	SD1(μg/mL)	SD2(μg/mL)
COLO 201	< 500	< 250
CCD19-Lu	< 500	< 250

*Cytotoxic properties of two dextran-coated nanoceria. (SD1 and SD2) against , COLO 201 (A), CCD-19Lu (B) cell lines at 100, 250, 500, 1000 µg/ml concentrations after 1 and 3 days treatment. * Represents comparison between SD1/ SD2 Day1 control group and each concentration, # Represents comparison between SD1/SD2 Day3 control group and each concentration, ** Represents comparison between SD1, Day1 and SD2, Day1 at the same concentration, ## Represents comparison between SD1, Day3 and SD2, Day3 at the same concentration (p-value≤0.001).*

CONCLUSION OF CYTOTOXICITY

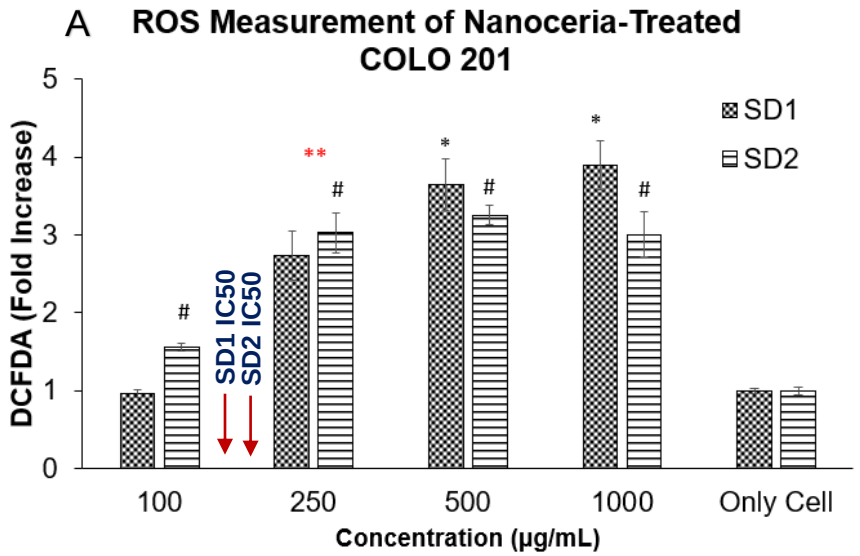
- SD2 is more toxic than SD1 at all concentrations.

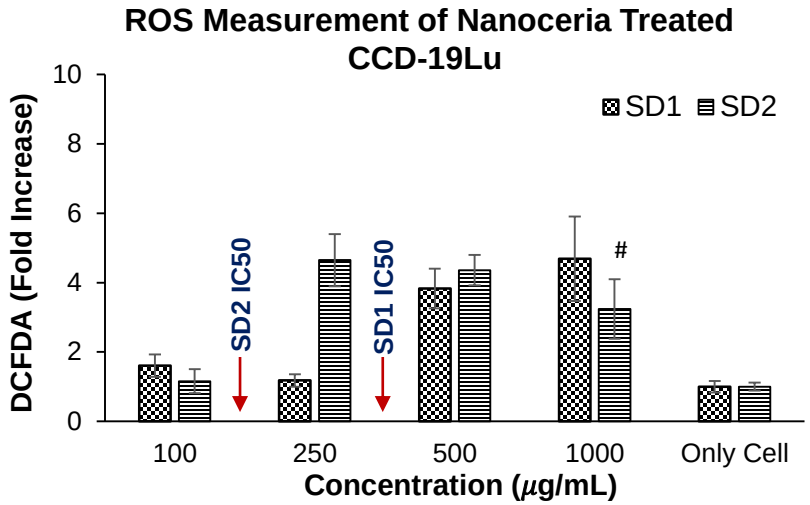
IC_{50} values comparison.

IC50 (µg/mL)	SD1	SD2
CCD-19Lu	745	215
COLO 201	232	124

In addition to first concentration series, additional WST-1 assay was performed with different concentration range to calculate accurate IC_{50} values via GraphPad V5.

ROS GENERATION OF DEX-CENPS (SD1 AND SD2) AGAINST COLO 201 AND CCD-19Lu





	SD1(µg/mL)	SD2(µg/mL)
COLO 201	< 250	< 250
CCD-19Lu	< 500	<250

ROS formation of two dextran-coated nanoceria. (SD1 and SD2) against DLD-1 (A), CCD-19Lu (B), cell lines at 100, 250, 500, 1000 µg/ml concentrations after 1 day treatment.
** Represents comparison between SD1/ SD2 Day1 control group and each concentration. (p-value≤0.001). # Represents comparison between SD1/SD2 Day3 control group and each concentration. (p-value≤0.001).*
*** Represents comparison between SD1, Day1 and SD2, Day1 at the same concentration. (p-value≤0.001).*

WORK FLOW

Cytotoxicity Assay (WST-1) and Reactive Oxygen Species (ROS) Assay

SD1

pH 6 and pH 7 Adjusted Characterization
(UV-Vis Spectroscopy, DLS)

pH Dependent Anti-Cancer Properties

SD2

Flow Cytometry Analysis and Gene Expression Profiles

FLOW CYTOMETRY ANALYSIS OF DEX-CENP (SD1)

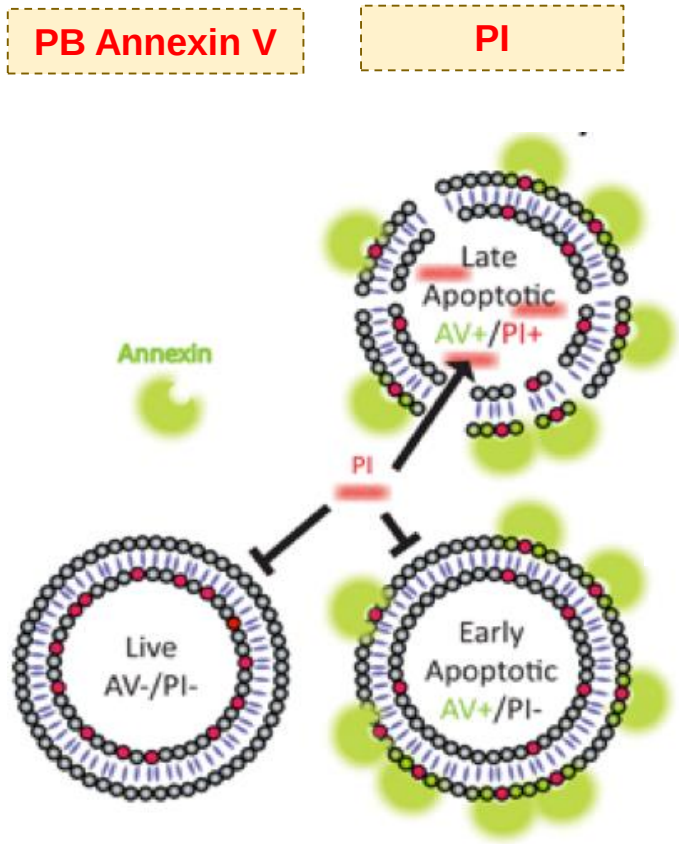


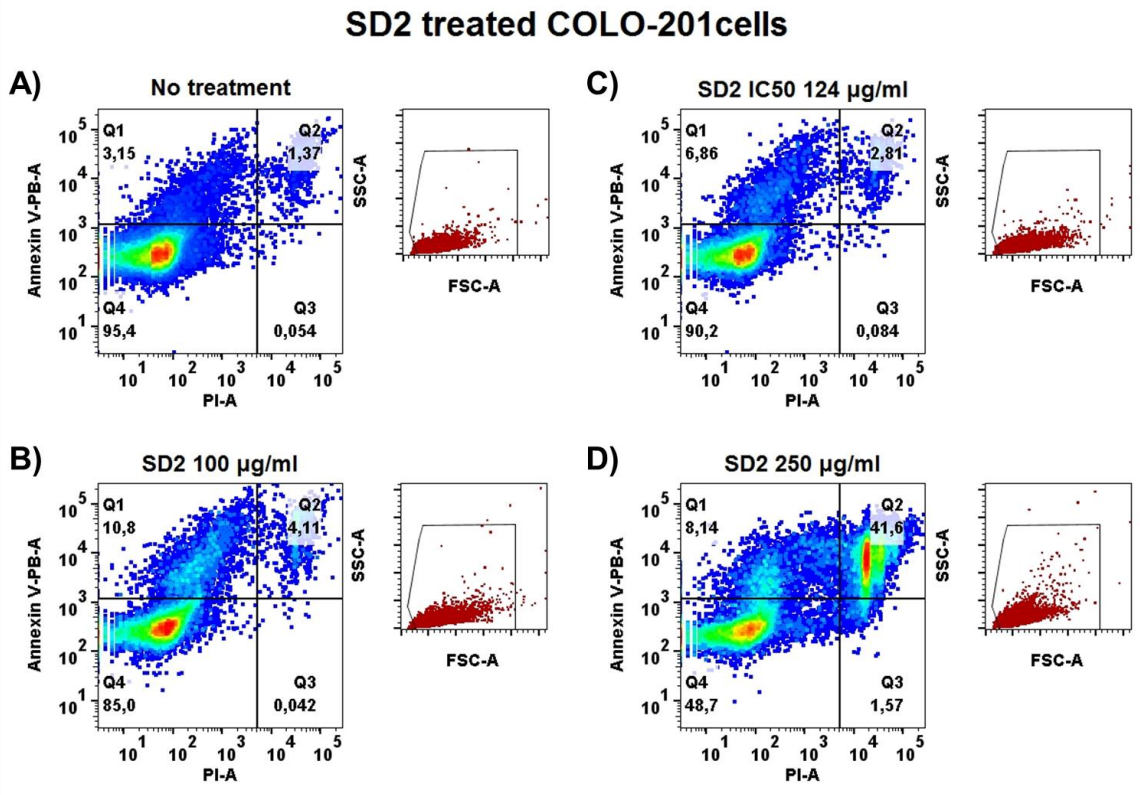
Figure 10: *Annexin V and PI expression.*

Table 2: *Diagrammatic representation of the expected flow cytometry results.*

Annexin V	PI
Annexin V^+ / PI^- **Early Apoptosis**	*Annexin V^+ / PI^+* **Late Apoptosis**
Annexin V^- / PI^- **Healthy**	*Annexin V^- / PI^+* **Necrosis**

Concentrations of dextran coated nanoceria (SD1 and SD2); IC_{50} values, a lower and an upper concentration value of IC_{50} values were selected.

FLOW CYTOMETRY ANALYSIS OF COLO 201



Comparison with untreated control group

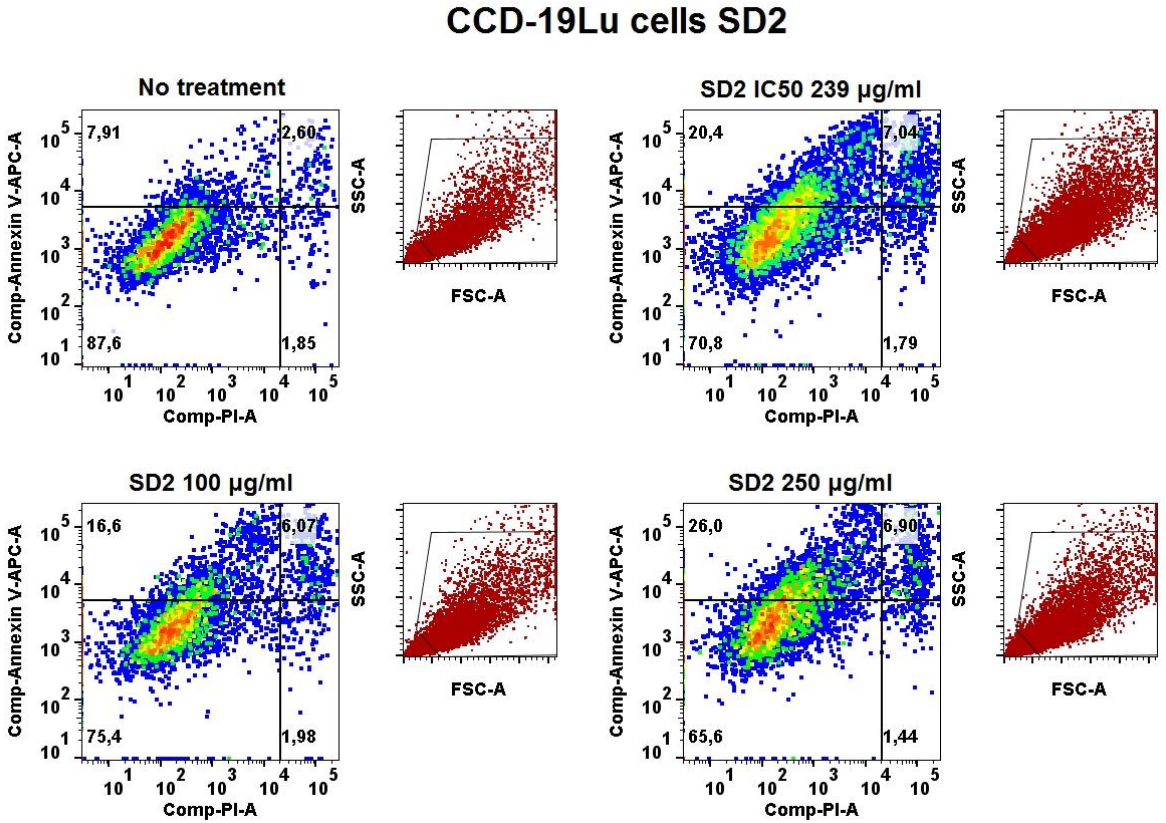
SD2

- 100 µg/mL → No Effect
- IC50 → Early Apoptosis
- 250 µg/mL → Late Apoptosis

Effect of dextran-coated nanoceria on apoptosis profile of in COLO-201 cells.

*COLO-201 cells were left **A)** untreated (negatif control) or treated for 24H with SD2 dextran-coated nanoceria at **B)** 100 mg/ml, **C)** IC50-124 mg/ml, **D)** 250 mg/ml. Cell apoptosis was measured using Annexin V-APC/PI double staining. Results are expressed as the percentage of cells corresponding to Q1: early apoptotic cells (Annexin V+/PI−); Q2: late apoptotic cells (Annexin V+/PI +); Q3: necrotic cells (Annexin V− PI+); and Q4: healthy. cells (Annexin V-/PI−). Red dot blots (SSC-A/FSC-A) represents corresponding backgate. Representatif example of 4 independent experiments.*

FLOW CYTOMETRY ANALYSIS OF CCD-19Lu



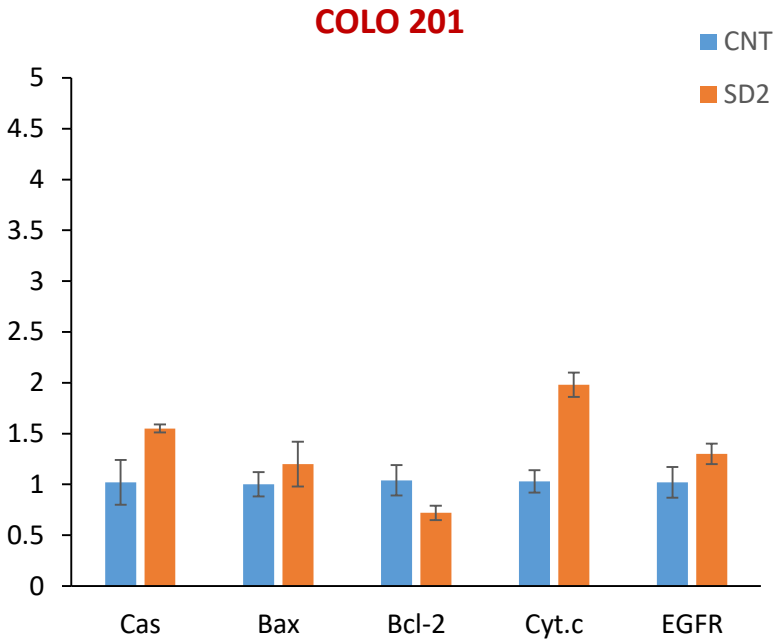
Comparison with untreated control group

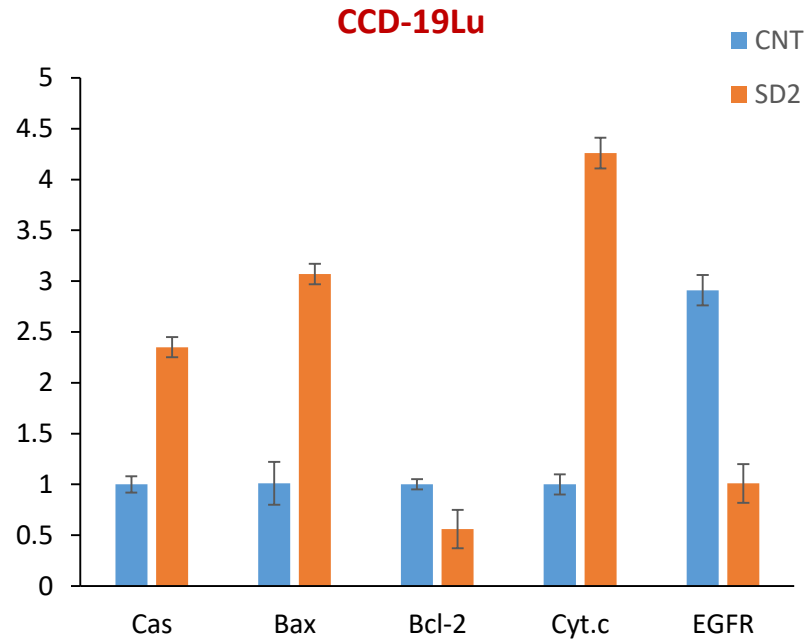
SD2

- 100 µg/mL → Early Apoptosis
- IC50 → Early and Late Apoptosis
- 250 µg/mL → Early and Late Apoptosis

Effect of dextran-coated nanoceria on apoptosis in CCD-19Lu cells.
CCD-19Lu cells were incubated 24H with dextran-coated nanoceria (left side: SD1; right side: SD2). Cell apoptosis was measured using Annexin V-APC/PI double staining. Results are expressed as the percentage of cells corresponding to Q1: early apoptotic cells (Annexin V+/PI−); Q2: late apoptotic cells (Annexin V+/PI +); Q3: necrotic cells (Annexin V− PI+); and Q4: healthy. cells (Annexin V-/PI−). Red dot blots (SSC-A/FSC-A) represents corresponding backgate. Untreated cells were used as negatif control. Representatif example of 3 independent experiments.The table below refers to the percentage of cells corresonding to each apoptotic level (Mean ± SD). Two-way ANOVA test with Tukey correction across each row is used to indicate statistical significance * P<0.05, ** P<0.01, *** P<0.001 vs. control.

RT- PCR ANALYSIS OF CCD-19Lu and COLO 201





Comparison of gene expression levels of selected genes in SD2-treated and untreated cells ((a) COLO 201, (b) CCD-19Lu. Signal intensities of relative genes are normalized to β-actin gene expression level. Quantitative results are presented as the mean ± SD from three independent experiments. Statistical significance was evaluated with Student t-test. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

THESES AND CONFERENCES

Master Thesis, Tarakci E, Pharmacological Potential of Cerium Oxide Nanoparticles through pH Dependency for Colon Cancer, 2023 Istanbul, Turkiye.

Undergraduate Thesis, Tarakci E, Kidik K. Electrochemical Detection of Glucose, 2020 İstanbul, Turkiye.

Oral Presentation, Tarakci E, Bilgin FM, Utku SF Yazici H Evaluation of Therapeutic Potential of Nanoceria via Surface Functionalization Strategies for Colon and Lung Cancer. 2nd Global Conference on Advanced Nanotechnology & Nanomaterials; 2022 Jun 22-23; Berlin, Germany.

Poster Presentation, Bilgin FM, Kidik K, Tarakci E, Yazici H. Selective Antitumor Activity of Nanoceria Against Non–Small Cell Lung Cancer.1st Global Nanobiotechnology E-Conference; 2021 Mar 13-20; Florida, USA

Poster Presentation, Tarakci E, Bilgin FM, Erdag B, Ozdemir-Bahadir A, Tekin S, Yazici H. A Comparative Study on Anti-Cancer Properties of Dextran-Coated Nanoceria against Colon and Lung Cancer. Bioturkiye International Biotechnology Congress Hybrid Conference; 2021 Sep 9-11; Ankara, Turkey.

Poster Presentation, Tarakci E, Bilgin FM, Yilmaz H, Utku SF, Yazici H. Pharmacological Potential of Cerium Oxide Nanoparticles through pH Dependency for Colon Cancer. European Material Science (E-MRS) 2021 Fall Meeting; 2021 Sep 20-23; Warsaw, Poland.


E-MRS 2021 Fall Meeting

Warsaw, 7th October 2021

Certificate of attendance

We hereby certify that Tarakci Elif, TUBITAK-Marmara Research Center / Yeditepe University, Turkey attended the E-MRS 2021 Fall Meeting held in Warsaw University of Technology from 20th to 23rd of September 2021.

Tarakci Elif presented a poster entitled "Pharmacological Potential of Cerium Oxide Nanoparticles Through pH Dependency For Colon Cancer".

On behalf of the Conference Organisers
Agnieszka Rytel
Conference Secretary


Peers Alley Media:
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CERTIFICATE
OF RECOGNITION

THIS CERTIFICATE IS PROUDLY PRESENTED TO

Elif Tarakci

Natural and Applied Sciences, Turkey

In recognition of outstanding contribution as a Distinguished Speaker of the presentation entitled

Evaluation of therapeutic potential of Nanoceria via surface functionalization strategies for colon and Lung Cancer

at

Berlin, Germany - 2nd Global Conference on Advanced Nanotechnology & Nanomaterials held during June 22-23, 2022

It's a great privilege to express sincere thanks and profound gratitude to present this award in recognition of your invaluable insights, experience and expertise.

Hepsiba Sunanda
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