



# Investigating Melanin Nanoparticles for Drug Delivery and Antioxidant Applications

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## I. Introduction

Melanin, an organic dark pigment naturally produced in most mammals' skin tissues, is known to neutralize reactive oxygen (ROS) and reactive nitrogen species (RNS). This project's objective is to produce a synthetic melanin nanoparticle (MNP)-based drug delivery system, capable of neutralizing ROS and RNS in affected tissues.

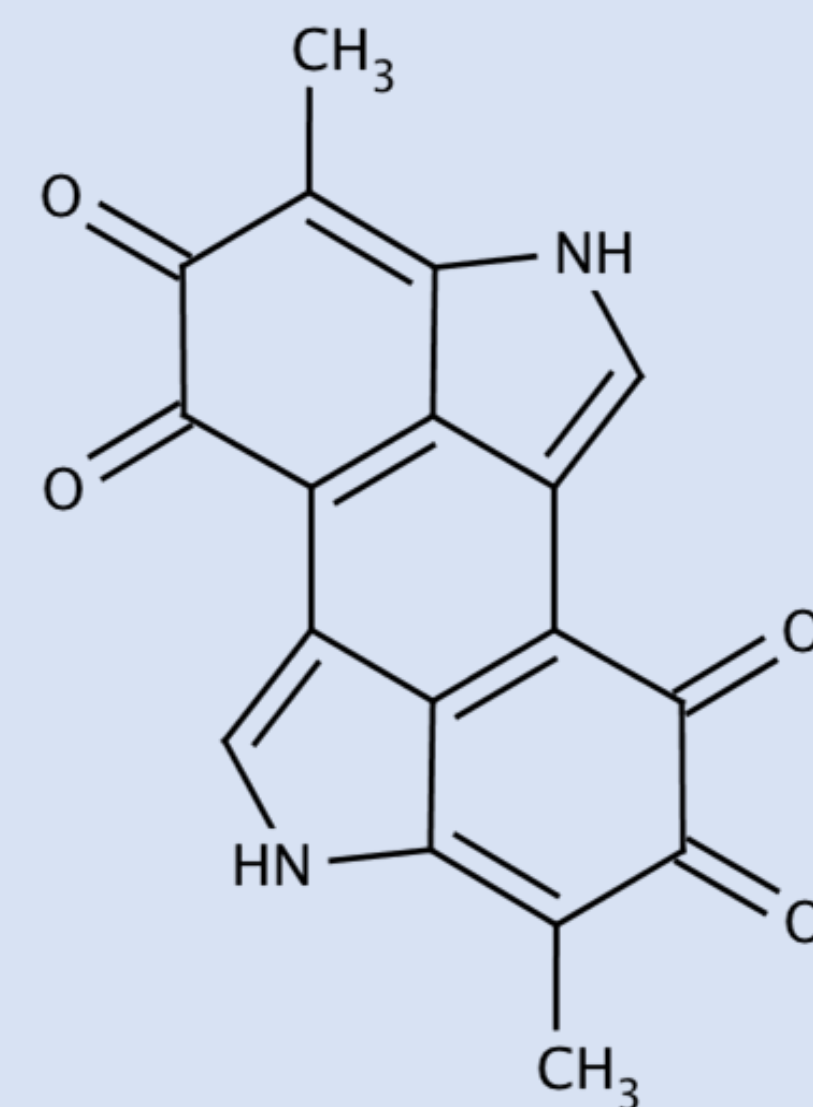
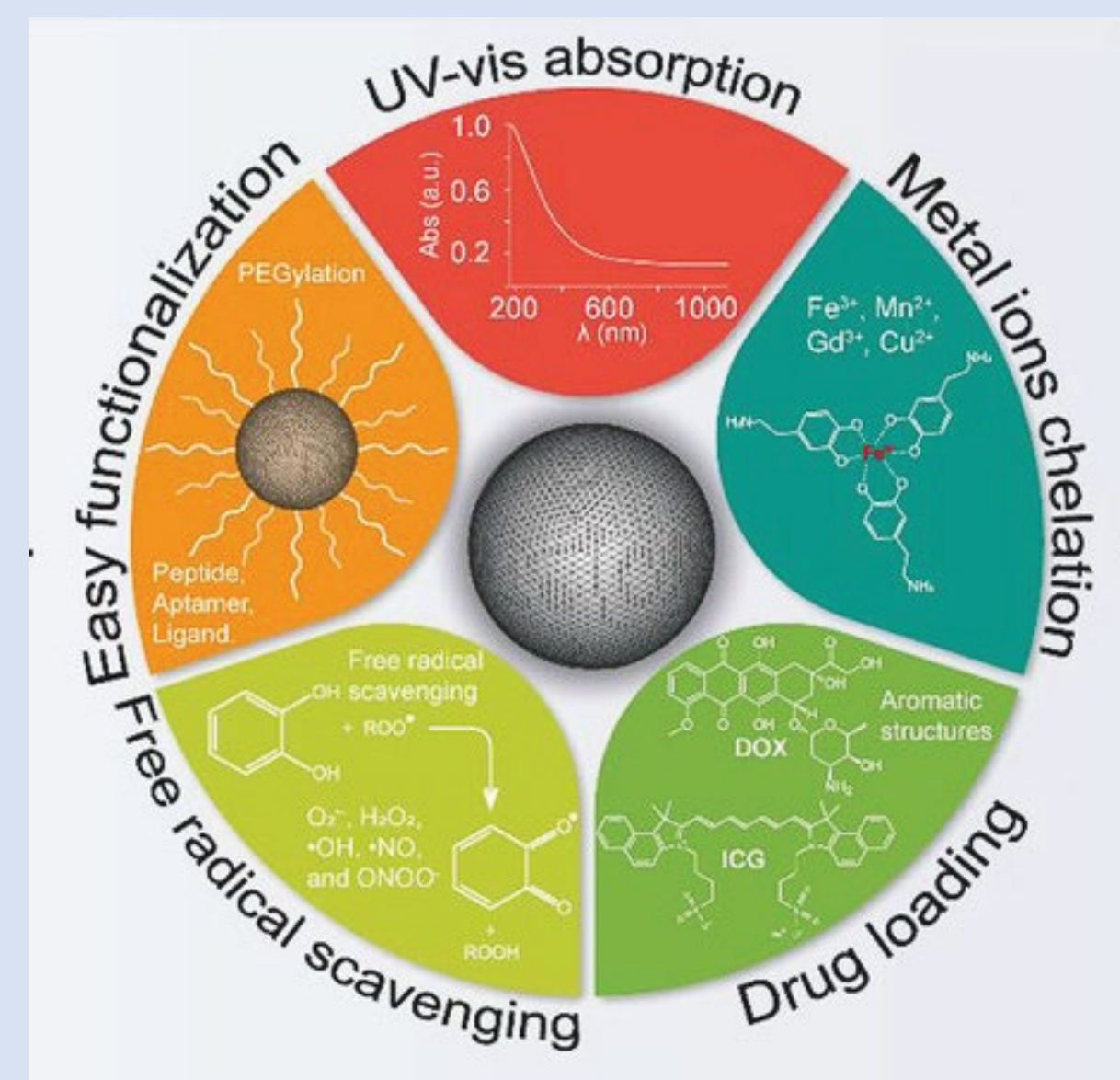


Fig 1: Structure of eumelanin

## II. Melanin: Biomedical applications



- Drug loading and delivery system
- Antioxidant properties for anti-inflammatory therapies and free radical scavenging

Goal: combination of both for novel treatments and multi-purpose drug delivery

Fig 2: Summary of potential biomedical applications of synthetic melanin nanoparticles.

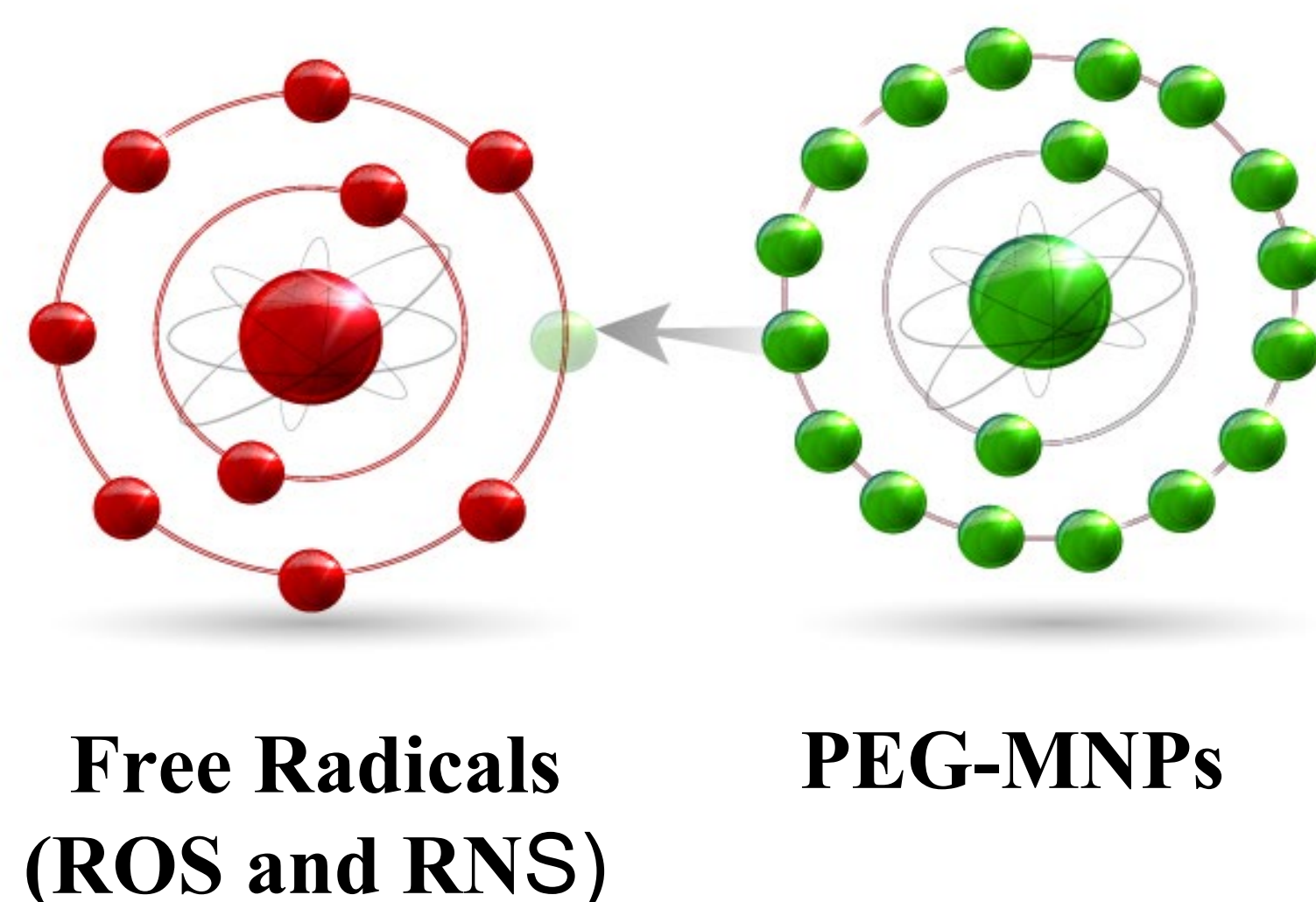


Fig. 3: Summary of mechanism of action of PEG-MNP acting as an antioxidant and neutralizing high-energy, unstable free radicals.

## III. Previous Results

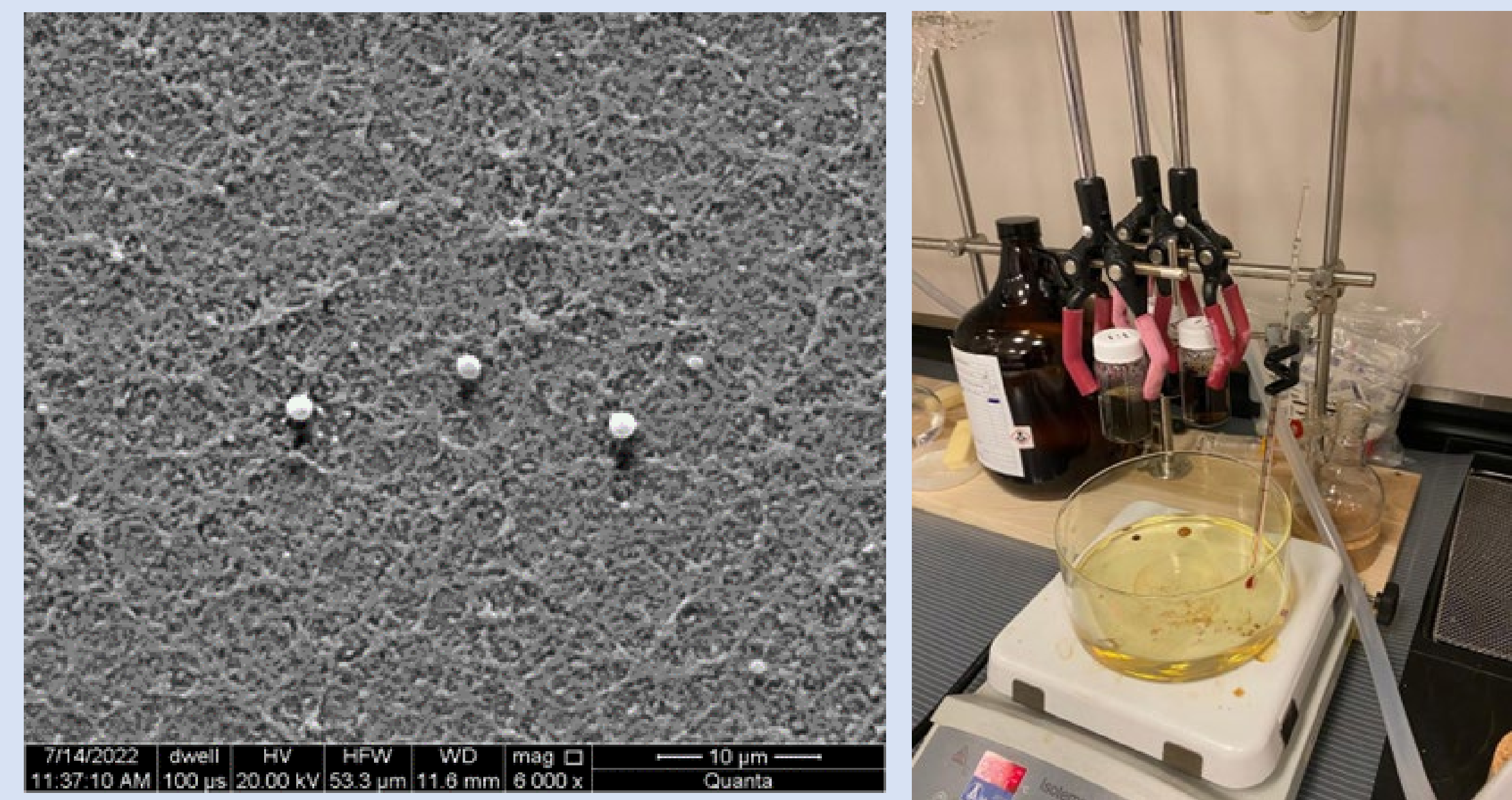


Fig 4: SEM of gold-coated 3% PVA-MNPs

Fig 5: Schematic image of the experimental setup for the synthesis of eumelanin nanoparticle

## IV. Materials and Methods

**Question:** Can PEG-MNPs deliver drugs and amplify their antioxidant potential?

**Objective:** synthesis of MNP-based drug delivery system + replication of natural melanin's antioxidant properties

1. Synthesis of PEG-MNP solutions
2. Loading of PEG-MNPs with DOx (doxorubicin)
3. Quantification of antioxidant potential of:

- DOx (control)
  - PEG-MNPs
  - DOx-PEG-MNPs
- } Antioxidant assays and DPPH assays

4. Controlled drug-release studies on DOx-PEG-MNPs

## Characterization Methods of Nanoparticles

- FTIR analysis
- SEM images with Energy Dispersive X-Ray

## Quantification of Antioxidant Potential

- Antioxidant assays
- DPPH assays

## IV. Future Applications

**RADIATION-INDUCED ROS and RNS in mice cells:**

**Question:** Can PEG-MNP treatment of cells prior/post exposure to UV rays decrease ROS/RNS?

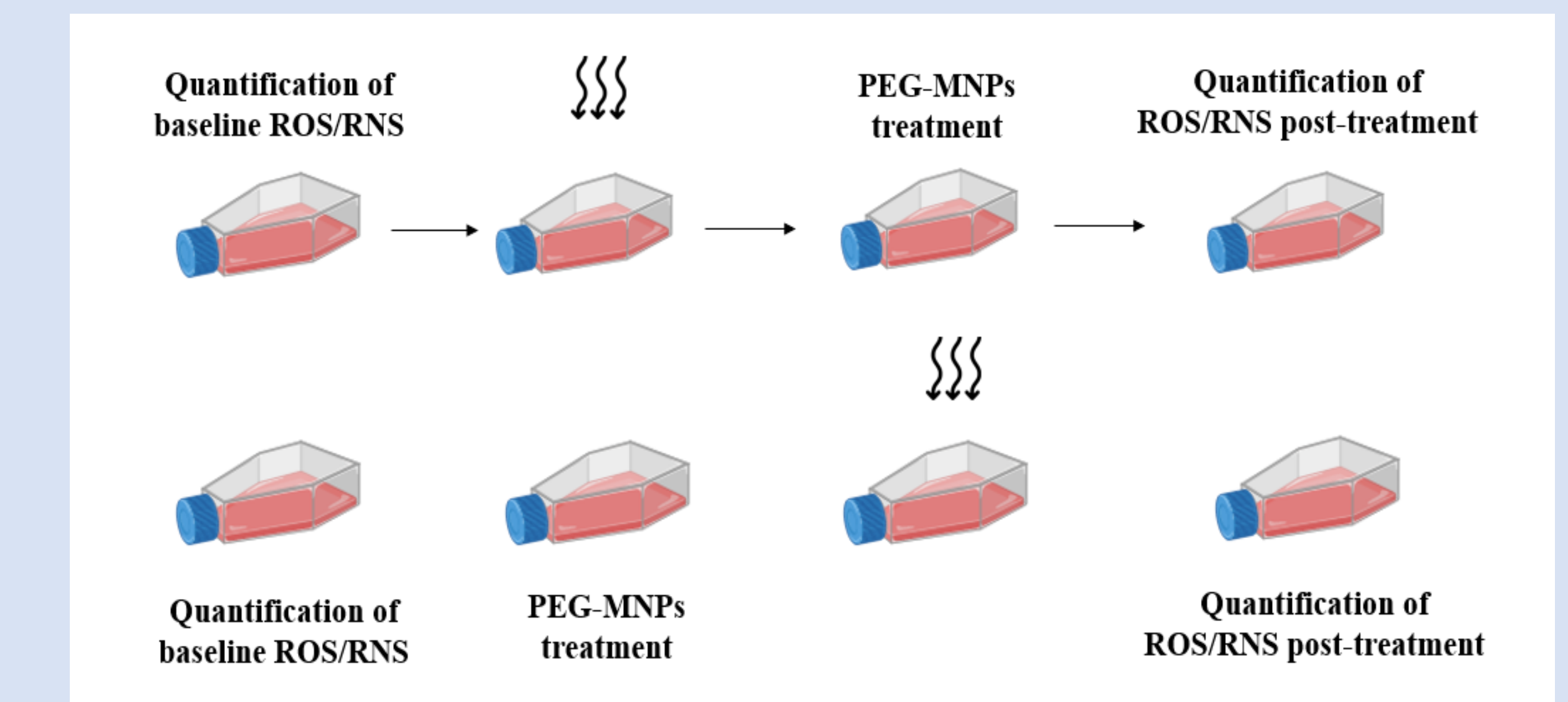


Fig 6: Schematic image of PEG-MNP treatments for the investigation of melanin's role in preventing/neutralizing ROS and RNS.

## V. References

- (1) Tran-Ly, A. N.; Reyes, C.; Schwarze, F. W. M. R.; Ribera, J. Microbial Production of Melanin and Its Various Applications. *World J. Microbiol. Biotechnol.* 2020, 36 (11), 170. <https://doi.org/10.1007/s11274-020-02941-z>.
- (2) Michalak, M.; Pierzak, M.; Kręcis, B.; Suliga, E. Bioactive Compounds for Skin Health: A Review. *Nutrients* 2021, 13 (1), 203. <https://doi.org/10.3390/nu13010203>.
- (3) Vasileiou, T.; Summerer, L. A Biomimetic Approach to Shielding from Ionizing Radiation: The Case of Melanized Fungi. *PLoS ONE* 2020, 15 (4), e0229921. <https://doi.org/10.1371/journal.pone.0229921>.