Investigating Melanin Nanoparticles for Radiation-blocking and Antioxidant properties

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I. Introduction

Melanin, an organic dark pigment naturally produced in the skin tissues of most mammals, is known to shield cells from radiation effects by absorbing ultraviolet rays. This project's objective is to fabricate a novel bio-inspired radiation-blocking material using melanin nanoparticles (MNPs)

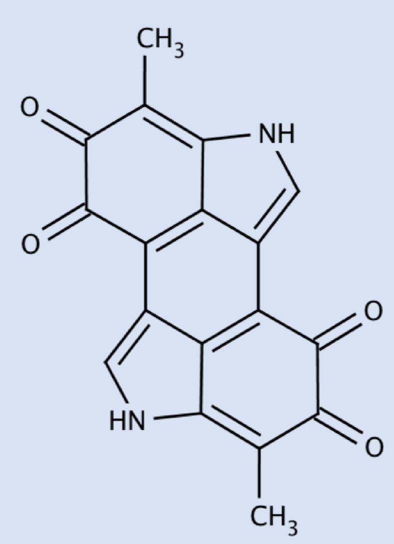


Fig 1: Structure of melanin, one of the most common naturally-occurring forms of melanin

II. MNPs as multi-functional tools

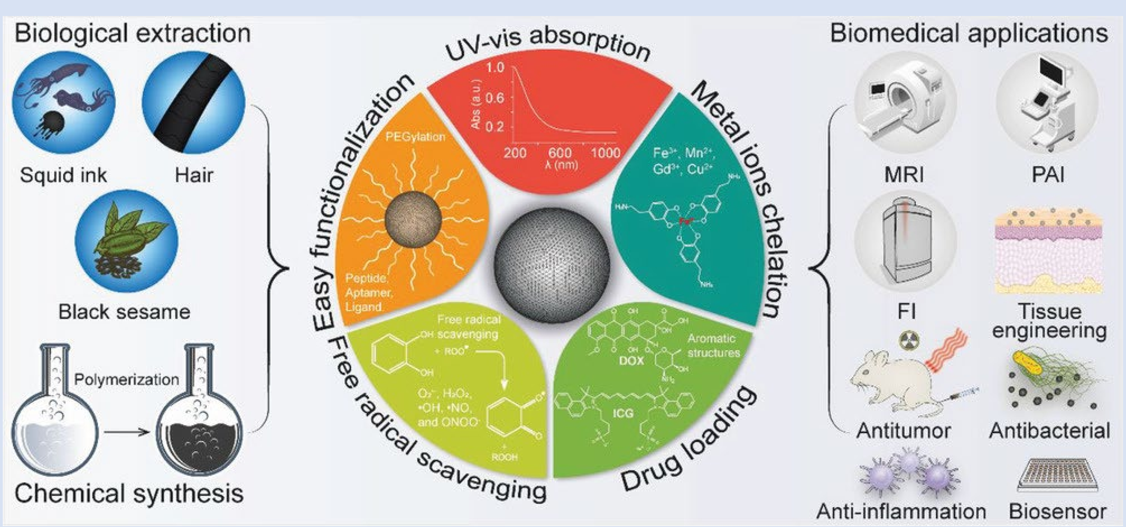
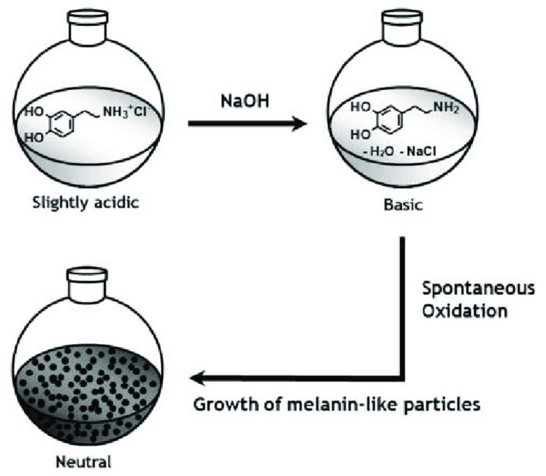


Fig 2: Summary of potential biomedical applications of synthetic melanin nanoparticles.

III. Materials and Methods



1. **Synthesis of 1:2 eumelanin MNPs (MNPs)**
2. **Conjugation of MNPs and polyvinyl alcohol (PVA)**
3. **Electrospray of thin films of PVA-MNPs**
4. **Radiation blocking tests on thin films**

Fig 3: Schematic of eumelanin MNP synthesis by spontaneous oxidation of dopamine hydrochloride with sodium hydroxide.

Characterization methods

- **UV/Vis Spectroscopy**
- **Fourier-Transform Infrared Spectroscopy (FT-IR)**
- **Optical Power Meter**
- **Scanning Electron Microscopy (SEM)**
- **Energy-Dispersive X-ray Spectroscopy (EDS)**

IV. Data Collection & Results

All characterization methods were conducted on MNPs dissolved in 2.5% PVA solution
All thin films were electrosprayed onto glass slides

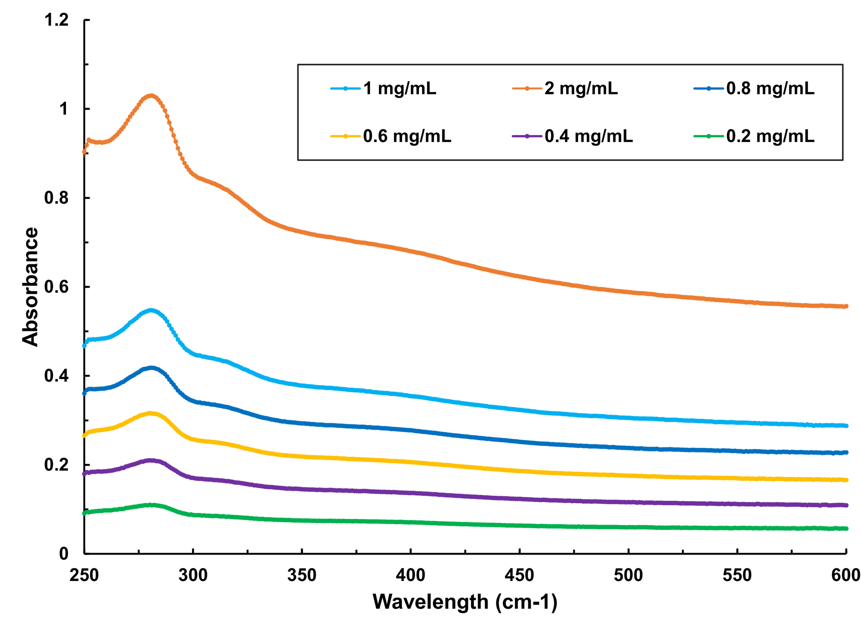


Fig 4: Absorbance of different concentrations of PVA-MNP solution at λmax = 280 nm.

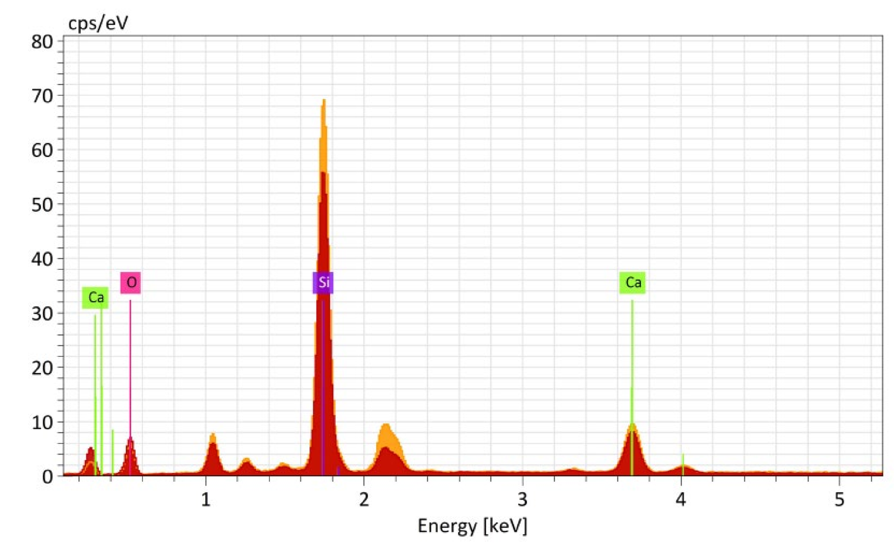


Fig 5: EDS comparison of MNPs in orange vs purchased purified melanin powder in red.

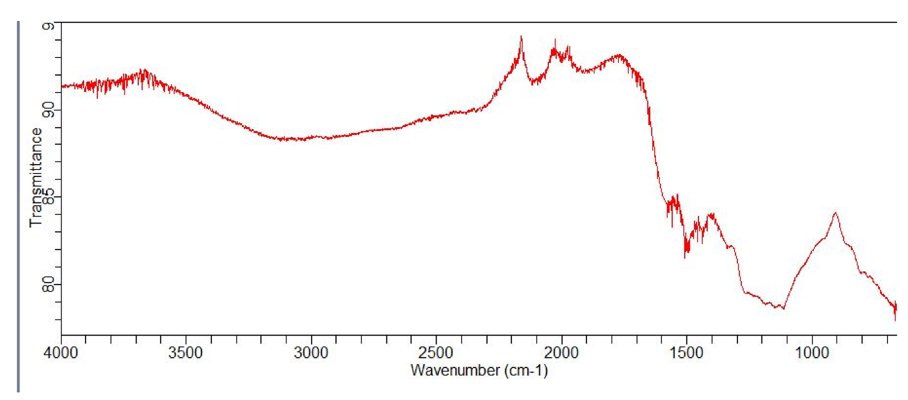
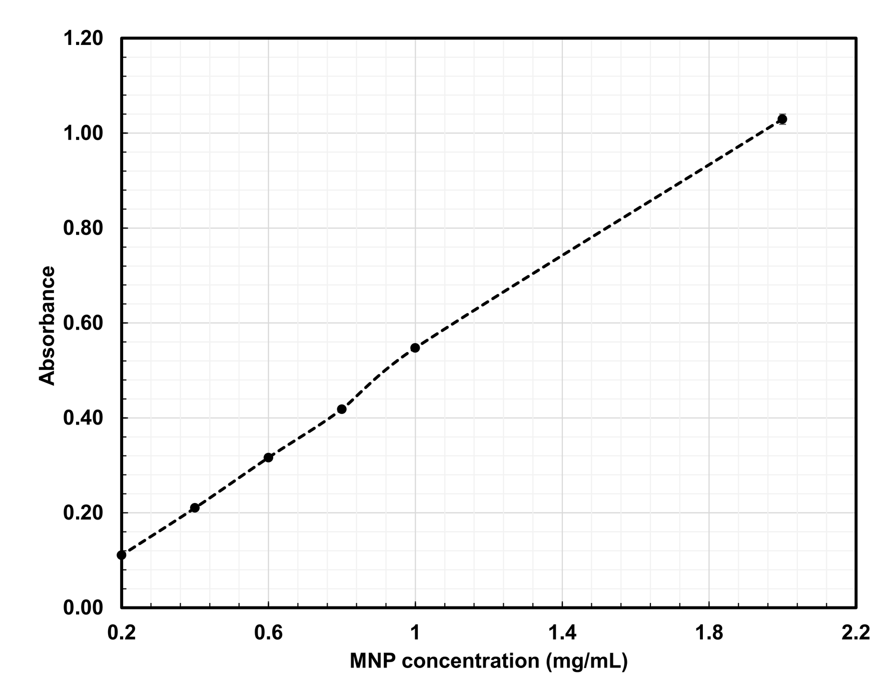


Fig 6: FT-IR scan of purified MNP powder



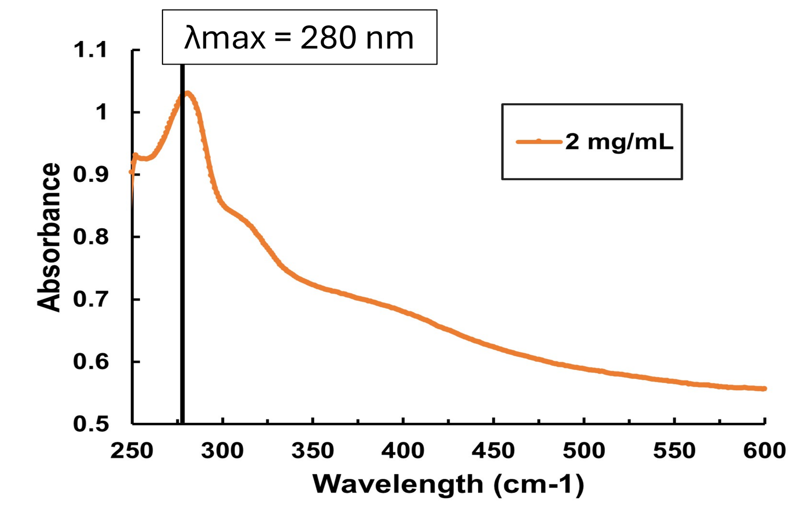
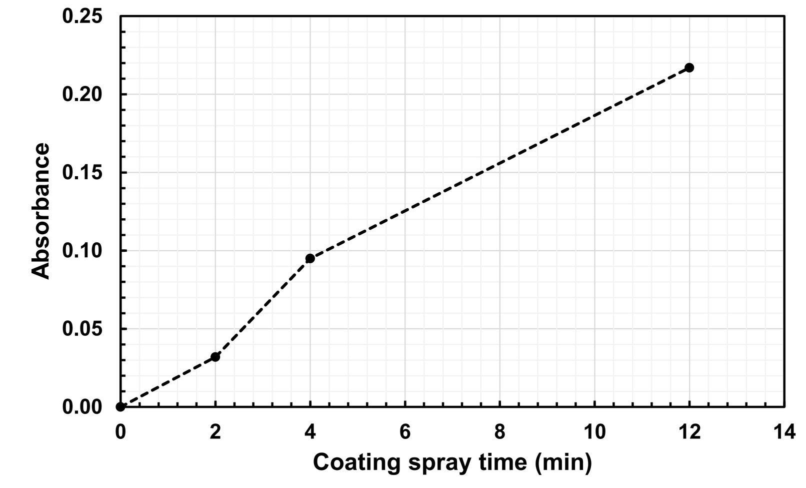


Fig 7: Linear relationship was established between absorbance vs MNP concentration (left); Fig 8: 2 mg/mL was used as reference concentration (right)



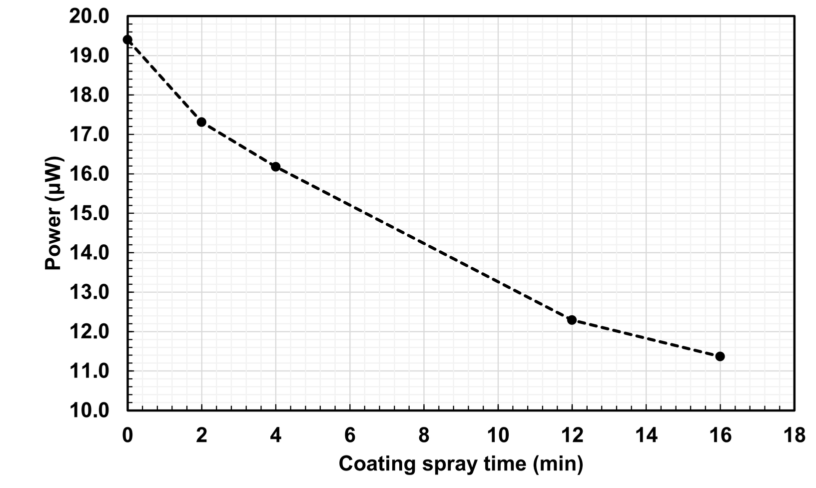


Fig 9: Absorbance of electrosprayed thin film of PVA-MNP with increasing coating spray times/increasing thickness (right); Fig 10: Optical powermeter readings of electrosprayed thin films of PVA-MNP with increasing coating spray times/increasing thickness (left)

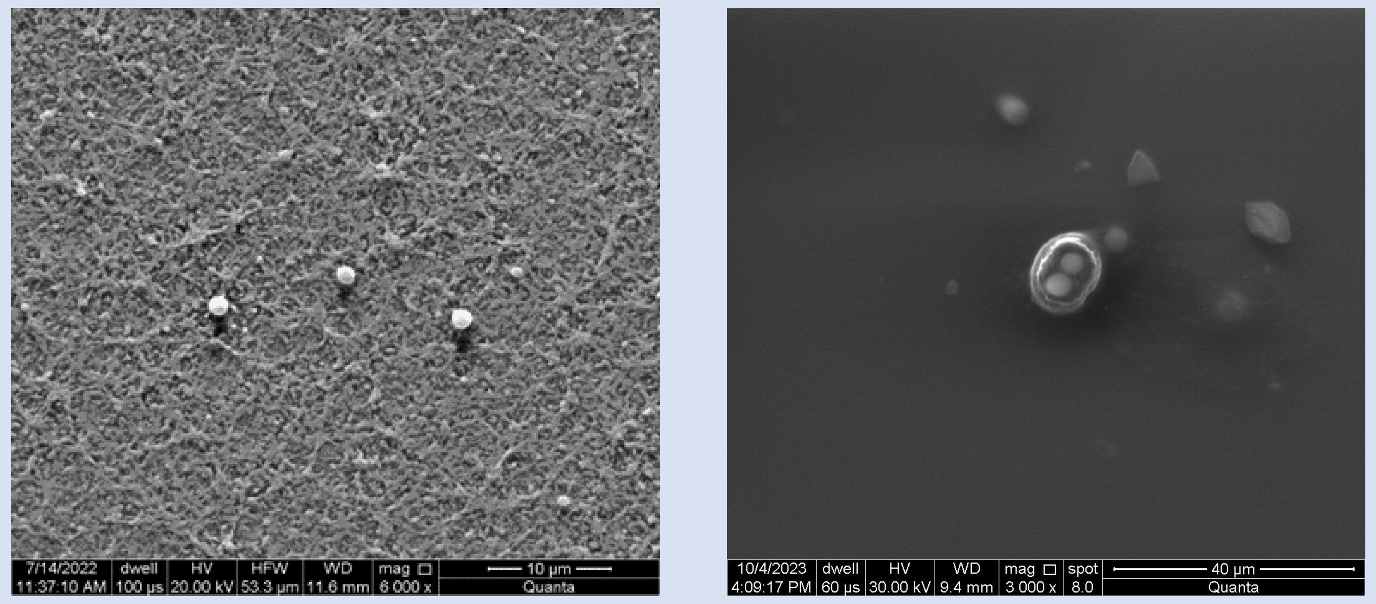


Fig 11: SEM image of 3% MNP dissolved in 10% PVA solution and electrosprayed onto glass slide (right); Fig 12: SEM image of 2 mg/mL MNP dissolved in 2.5% PVA electrosprayed onto glass slide (spray time = 4 min (left)

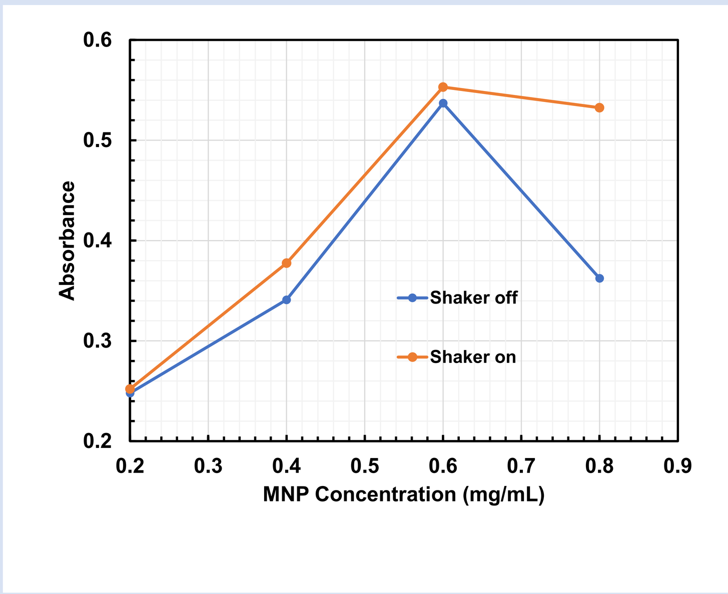


Fig 13: Antioxidant assay of MNP solutions; comparison of absorbance readings with shaker on vs off.

- 0.6 mg/mL – saturation point
- 0.8 mg/mL – oversaturation and sedimentation

→ Next step: Improve MNP solubility in different solvents

IV. Future Directions

- **Gamma radiation blocking tests**
- **Profilometer for assessment of film thickness**
- **Antioxidant assay to confirm saturation level of MNPs**
- **Publication**

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.; Kręcisz, B.; Suliga, E. Bioactive Compounds for Skin Health: A Review. Nutrients 2021, 13 (1), 203. https://doi.org/10.3390/nu13010203.

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