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Polyethyleneimine Stabilized Silver Nanoparticles as an Efficient and Selective Colorimetric Assay for Promethazine

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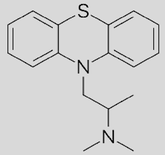
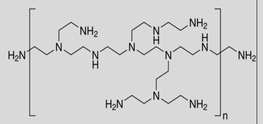
Introduction

- **Promethazine** is FDA-approved first-generation antiemetic, antihistamine, and H1 receptor antagonist drug.
- Used for the treatment of vomiting and nausea caused by cancer chemotherapy, migraine episodes, narcotic therapy.
- It cause significant sedation, agitation, hallucinations, and possibly apparent life-threatening events or sudden infant death syndrome.



Promethazine

- **Polyethylenimine (PEI)** is a synthetic polymer with high cationic charge density
- First used as gene delivery with great gene delivery potential.
- 25 Kda PEI considered as gold standard in gene Delivery.



Branched PEI

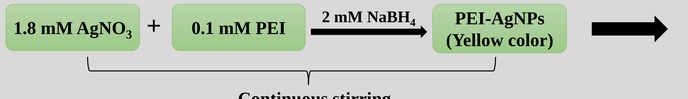
- **Silver Nanoparticles (AgNPs)** are efficient in sensing purpose by signal enhancement.
- AgNPs possess good electrical and catalytic property
- Excellent biocompatibility.
- Lower cost

Diff. color of AgNPs with their approx. sizes

- Considering the present investigation, the colorimetric sensing was done for the Promethazine based on PEI (Mn= 25,000 g/mol) modified silver nanoparticles synthesized by chemical reduction method.

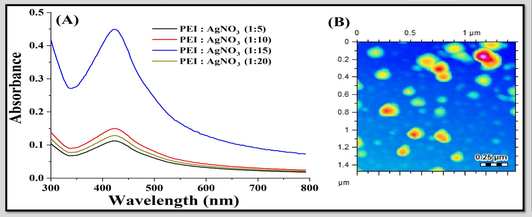
Synthesis and Characterization of PEI-AgNPs

- **Ratio = PEI : $AgNO_3$**
  1 : 15



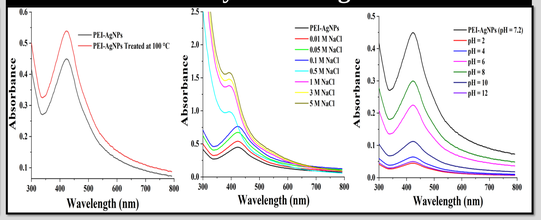
UV-visible Spectroscopy

AFM



(A) UV-visible spectrum of PEI-AgNPs (B) 2-D AFM Image of PEI-AgNPs

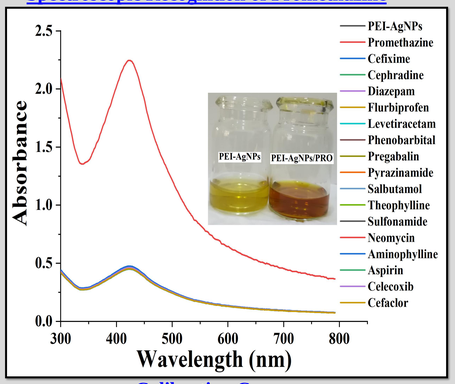
Stability of PEI-AgNPs



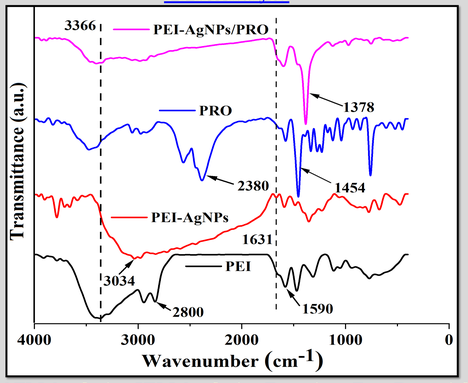
(A) before and after exposure at 100°C (B) Spectra at different concentrations of NaCl (C) pH variation

PEI-AgNPs and Drug Interaction

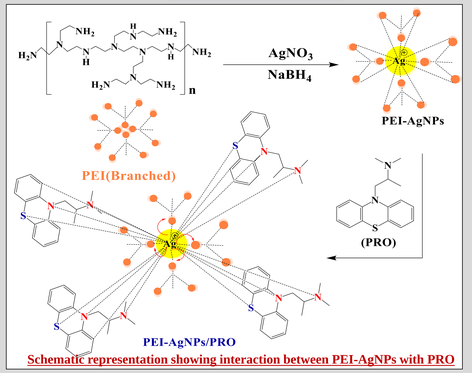
Spectroscopic Recognition of Promethazine



FT-IR Analysis

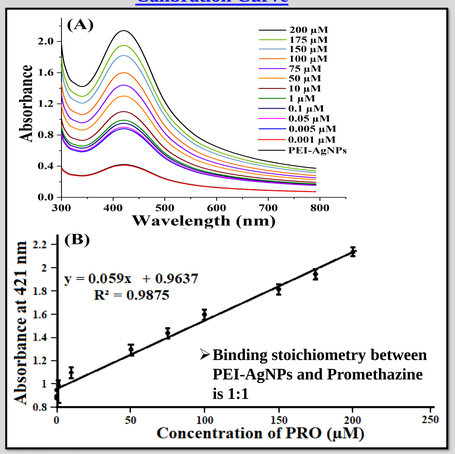


Reaction Mechanism



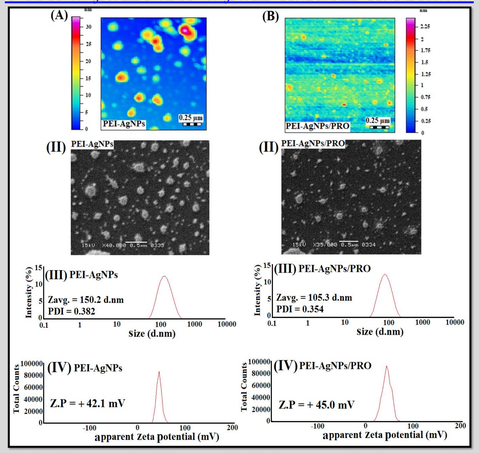
Schematic representation showing interaction between PEI-AgNPs with PRO

Calibration Curve



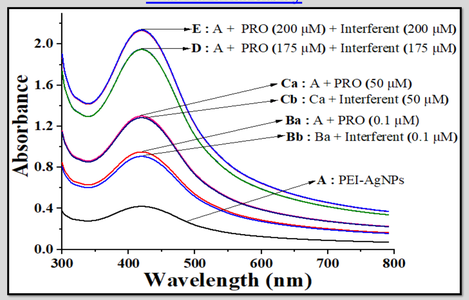
A) UV-visible spectra by using various concentrations of PRO with PEI-AgNPs B) Calibration curve for amount of PRO at 421 nm

AFM Analysis SEM Analysis Zeta size Zeta Potential

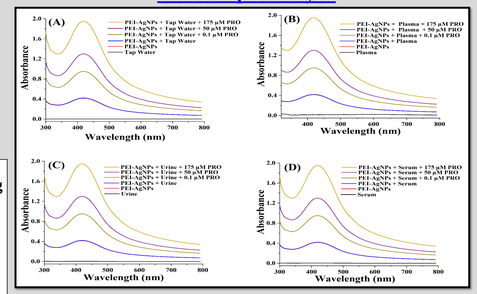


(A) (B) AFM images (II) SEM images (III) (IV) Zeta size and Zeta Potential of PRO with PEI-AgNPs

Interference Study



Real Sample Analysis



(A) Tap Water (B) Blood Plasma (C) Urine (D) Serum

CONCLUSION

- A simple and quick way to achieve stable PEI-AgNPs by introducing $NaBH_4$ as a reducing agent and PEI as a stabilizing agent.
- Colorimetric detection by PEI modified AgNPs is successfully established for Promethazine.
- Change in the morphology is confirm by using AFM, SEM, and DLS.
- Linear range of 0.005-200 µM, low LoD of 0.003 µM and LoQ of 0.008 µM was found.
- This sensor was successfully applied for the detection of PRO in environmental and biological sample.