Design and Development of a Targeted Molecular Probe for Ultrasensitive Early Detection of Breast Cancer

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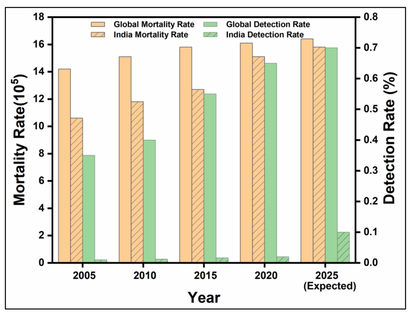
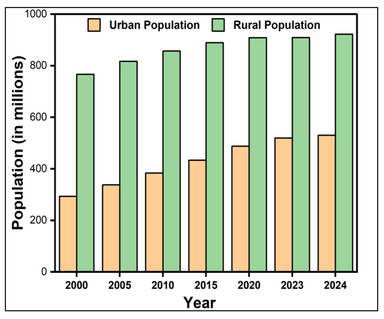
Background

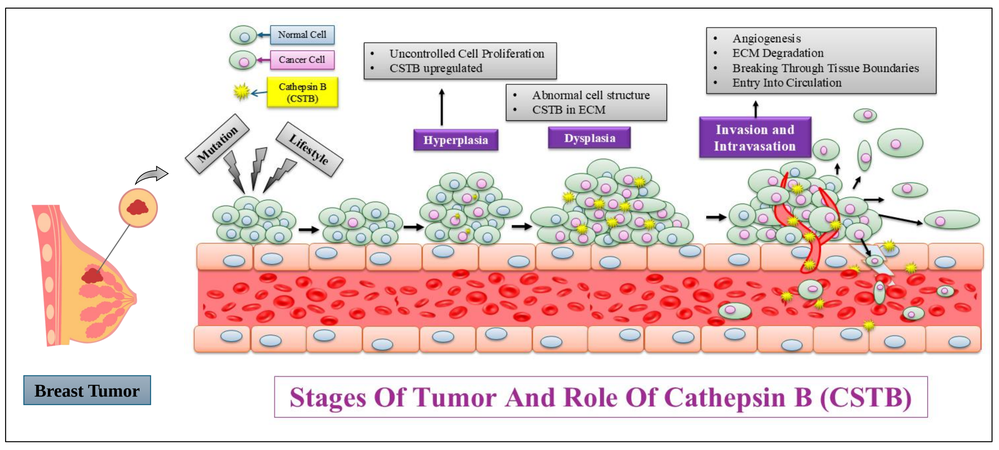
"While completely preventing breast cancer remains a challenge, but the casualties due to breast cancer can be reduced, through early detection."

According to the Global Cancer Observatory (ICAR-WHO, 2022), breast cancer is the most prevalent cancer worldwide, with an estimated 660,000 deaths among females in 2022. India recorded the highest number of estimated breast cancer fatalities, with ~100,000 deaths in the same year.



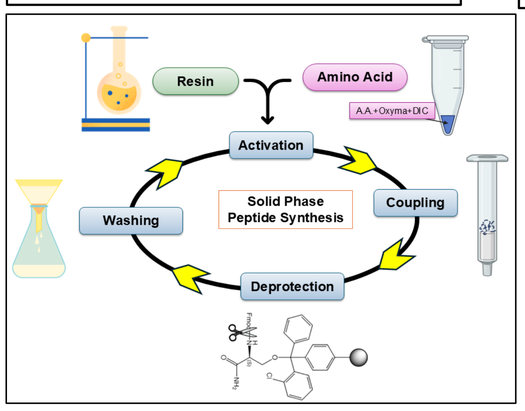
Factual Data

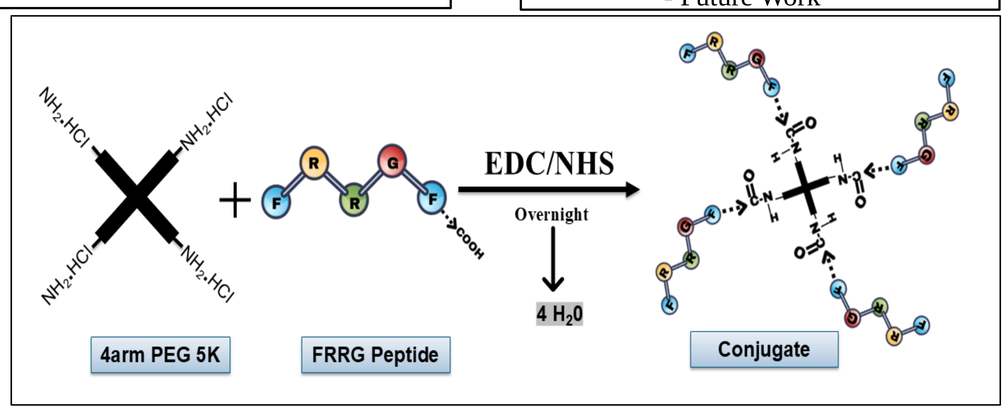




Objectives and Methodologies

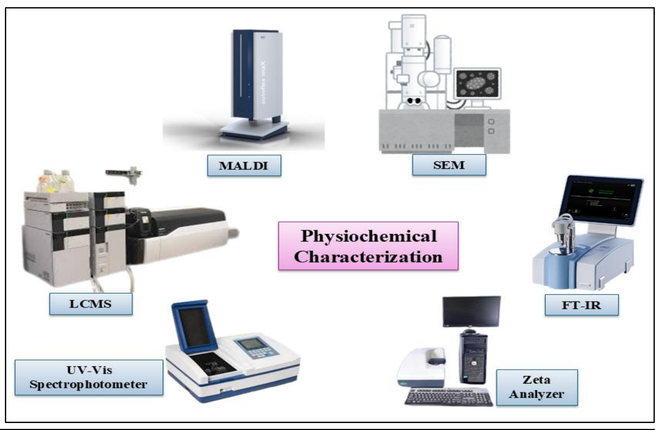
Objective 1: Probe Designing → **Objective 2: Probe Conjugation with Polymer and Nanoparticle Synthesis** → **Objective 3: Encapsulating the MRI Contrast agent with the Probe and Polymer conjugate** - Future Work





Studies

- Synthesis of probe for CSTB using Solid Phase Peptide Synthesis and characterized with LC-MS and MALDI.
- Conjugation of Biomarker and 4arm-PEG5K Using EDC/NHS Coupling: Analysis via MALDI, FTIR, UV-Vis Spectrophotometry, and Zeta Potential Measurement.
- Probe's Nanoparticles synthesis and its characterization with SEM, EDS and DLS.

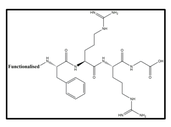


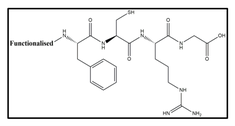
Results

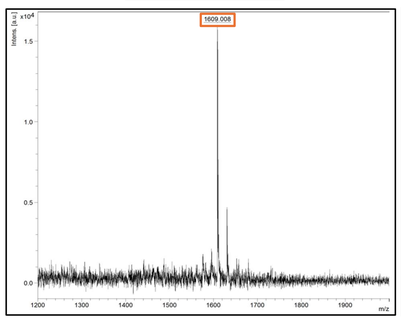
MALDI

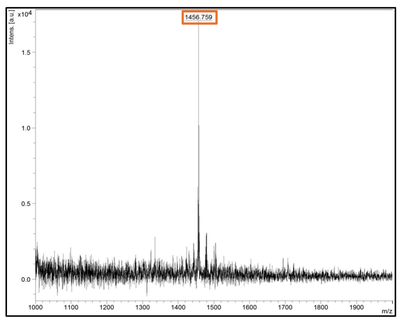
FRRG-Pep 1
Approx mass = 1608.92 g/mol

FGR-Pep 2
Approx mass = 1456.75 g/mol

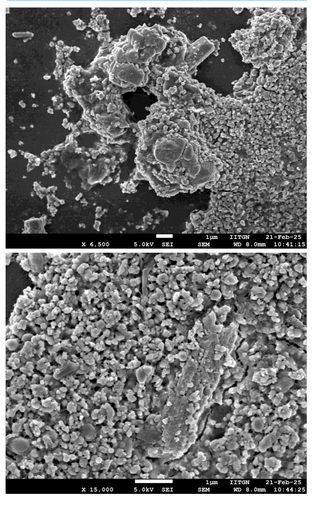




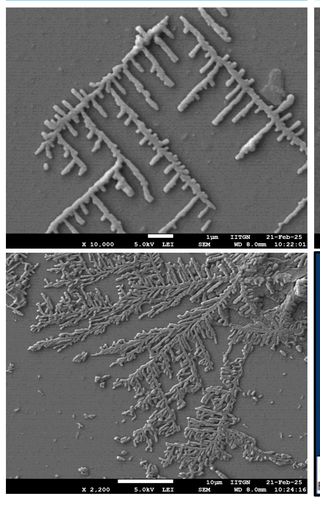




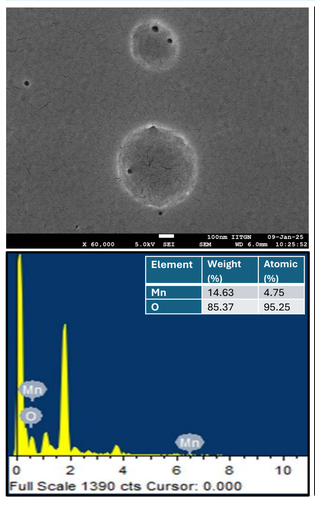
SEM of PEG5K



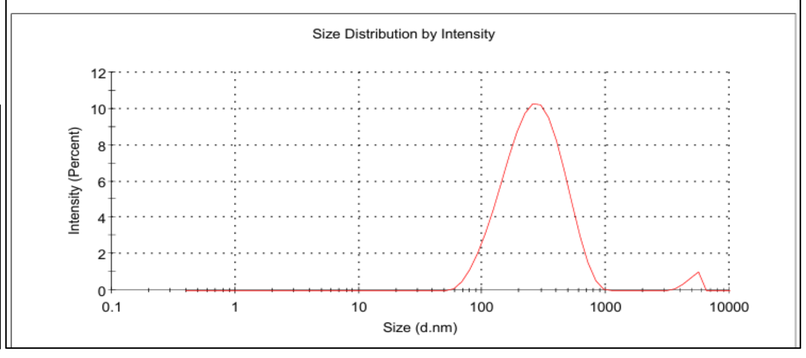
SEM of conjugate



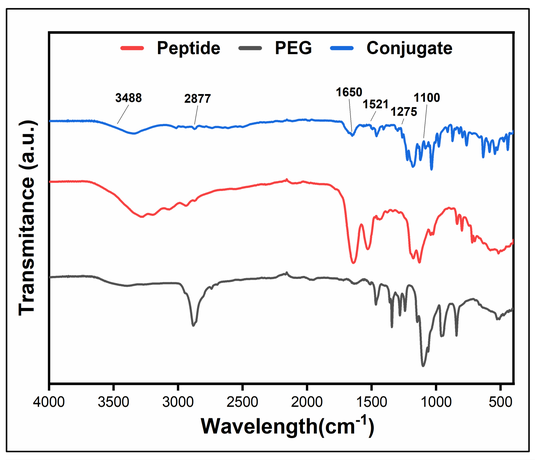
MRI Contrast Agent (SEM, EDS and DLS)



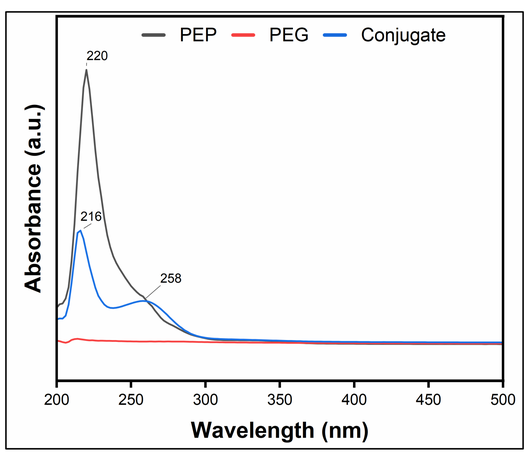
		Size (d.nm):	% Intensity:	St Dev (d.n...
Z-Average (d.nm): 239.6	Peak 1:	288.1	97.9	148.3
PdI: 0.247	Peak 2:	5004	2.1	606.8
Intercept: 0.940	Peak 3:	0.000	0.0	0.000
Result quality : Good				



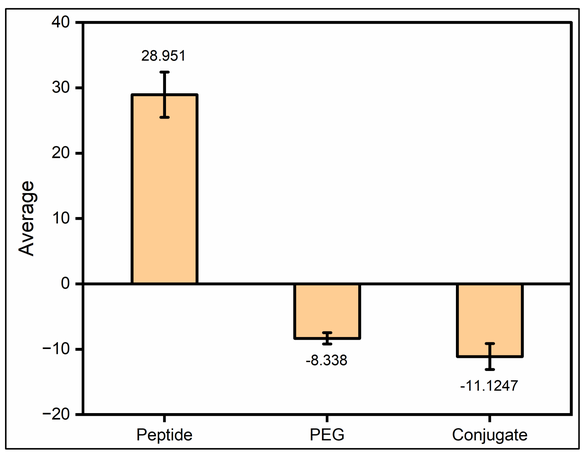
FT-IR



UV-Vis Spectrophotometer



Zeta-potential



Future Studies

Synthesis of the probe complex for early breast cancer detection

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Structural characterization

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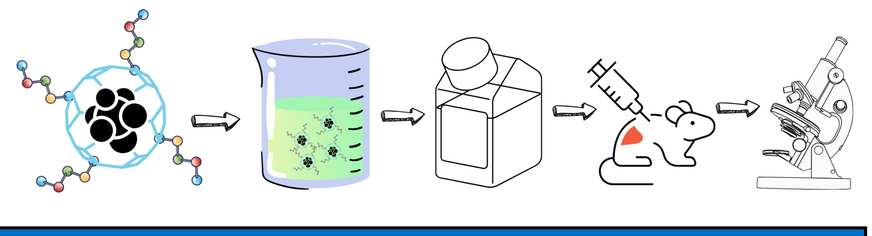
In-Vitro and *In-Vivo* study



Conclusion

- A 12-amino acid peptide probe targeting Cathepsin B and a control peptide were synthesized using solid-phase peptide synthesis and characterized via LC-MS and MALDI.
- The peptides were conjugated with functionalized 4arm-PEG5K using EDC/NHS coupling, confirmed through FTIR, UV-Vis spectrophotometry, and zeta potential measurements.
- MRI contrast agent nanoparticles were synthesized and characterized using SEM, EDS and DLS meeting physicochemical criteria, with the next step involving *In-vitro* and *In-vivo* assays for biomarker targeting efficiency.

Acknowledgment

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