Isabgol (Psyllium) Nanoparticles Functionalized with Hyaluronic Acid from Engineered *Lactococcus Lactis* for Drug Delivery

Vasudha T K, Kartik Mitra, Vignesh Muthuvijayan*

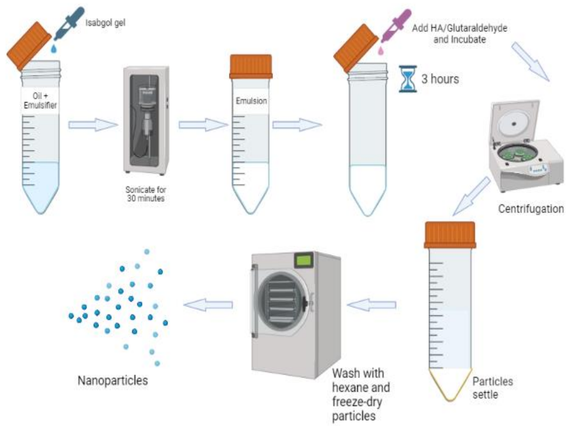
Bhupat and Jyoti Mehta school of Biosciences, Department of Biotechnology
Indian Institute of Technology Madras, Chennai, India

**vigneshm@iitm.ac.in*

INTRODUCTION

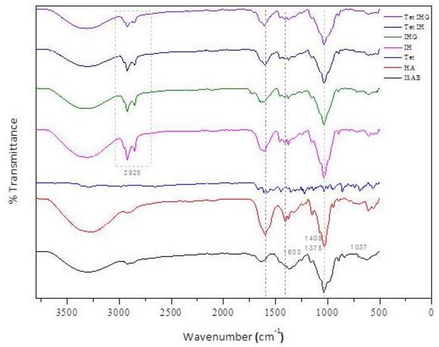
- Diabetic wounds are chronic, non-healing wounds that require medical attention and care.
- Nanoparticles exhibit high surface-to-volume ratios that improve the biological interactions and penetration at the wound site.
- Nanoparticles are ideal for the sustained delivery of drugs and biomolecules to the wound site to promote cell adhesion and proliferation, vascularization, and/or to prevent infection.
- We have developed tetracycline-loaded, isabgol (ISAB, psyllium) gel nanoparticles functionalized with hyaluronic acid (HA) obtained from metabolically engineered *Lactococcus lactis* for the effective treatment of diabetic wounds.

MATERIAL SYNTHESIS

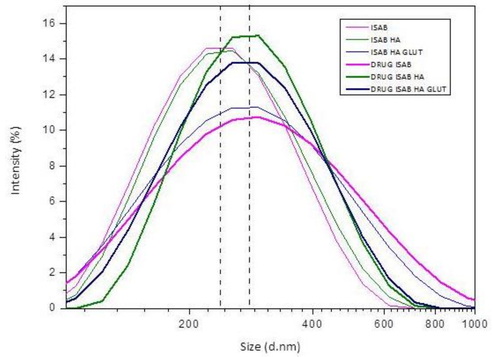


Synthesis of ISAB nanoparticles by emulsification technique and their functionalization with HA

MATERIAL CHARACTERIZATION



FTIR Spectra confirm the functionalization of HA on ISAB nanoparticles



Intensity vs size distribution of nanoparticles

Sample	Size (nm)	Zeta potential (mV)
ISAB NPS	113.1	-27.8
ISAB HA	112.7	-33.6
ISAB HA GLUT	119.7	-35.6

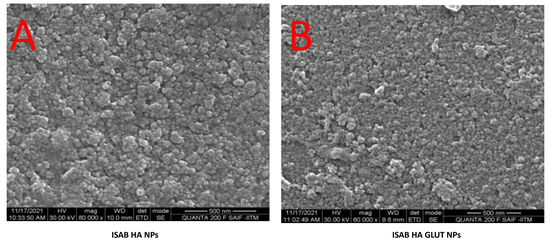
Sample	Size (nm)	Zeta potential (mV)
Drug ISAB	123.2	-14.3
Drug ISAB HA	133.7	-31.8
Drug ISAB HA GLUT	123.8	-37.5

Size and zeta potential of nanoparticles obtained through DLS experimentation

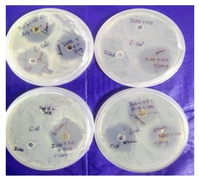
MATERIAL CHARACTERIZATION

Sample	Encapsulation efficiency (%)	Loading capacity (%)
ISAB HA	92.72	31.0
ISAB HA GLUT	92.30	30.7

Drug encapsulation efficiency and loading capacity of nanoparticles

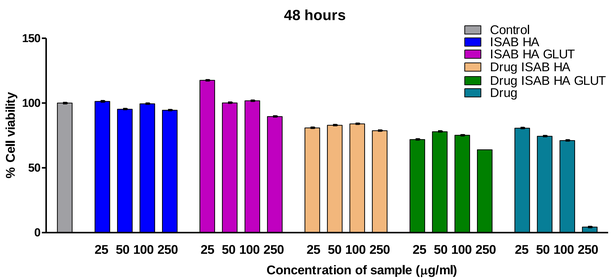


SEM micrographs of ISAB Nanoparticles functionalized with HA by A)physical adsorption B) Glutaraldehyde crosslinking



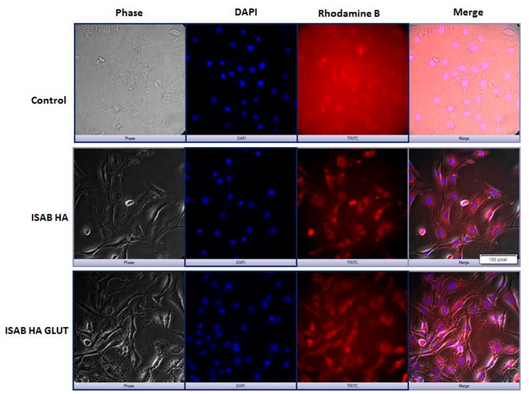
	Zone dia (mm)	
Sample	*E. coli*	*S. aureus*
Drug ISAB HA	30	27
Drug ISAB HA GLUT	30	27
Drug (+ve control)	30	27

Antibacterial activity of nanoparticles against *S. aureus* and *E. coli* by disc diffusion assay



Cytotoxicity of nanoparticles on 3T3 L1 fibroblast cell line by MTT assay

BIOLOGICAL CHARACTERIZATION



Cellular uptake of nanoparticles tagged with rhodamine B. Nuclei stained with DAPI.

CONCLUSIONS

- Drug loaded ISAB HA nanoparticles were successfully prepared and characterized.
- The nanoparticles showed excellent cellular internalization, antibacterial activity and were found to be non-toxic.
- The nanoparticles can be loaded with the antibiotic tetracycline at high encapsulation efficiency and loading capacity.
- Further, *in vivo* wound healing efficacy of the nanoparticles needs to be assessed for clinical applications in diabetic wound treatment.

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V. Kumar, Polym Bull, 2014; 71.
M.R. Vijayakumar, Colloids Surf. B, 145 (2016) 479-491.