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Cardiomyocyte-Loaded Polymeric Microsphere Design for Treatment of Cardiac Regeneration after Myocardial Ischemia and *in vitro* Evaluation

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MOTIVATION & AIM

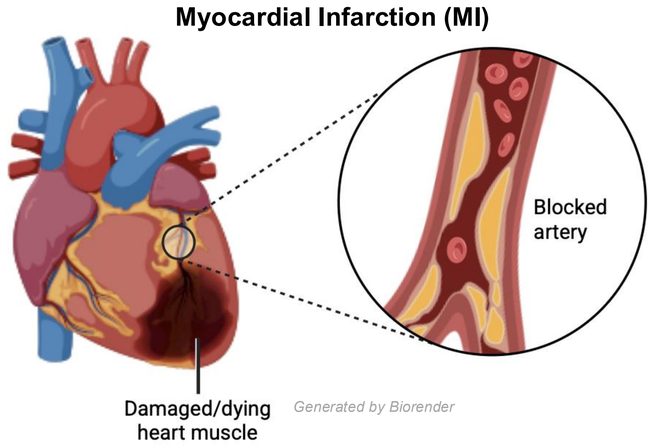

Figure 1. Shematic representation of the MI

The primary conditions that cause MI:

- Coronary artery disease (atherosclerosis): Plaques composed primarily of cholesterol—accumulate on your artery walls and restrict blood flow. Atherosclerosis is the most common cause of myocardial ischemia.
- Blood clot: Plaques that develop due to atherosclerosis can rupture and trigger blood clot formation. A clot can block an artery, leading to sudden, severe myocardial ischemia.
- Coronary artery spasm: Temporary tightening of the muscles in the artery wall can reduce or even block blood flow to a portion of the heart muscle.
- Oxidative stress resulting from myocardial ischemia causes severe damage to the heart muscle.

➢ **The aim of this project to develop dual-functional antioxidants loaded microspheres(MS) and capable of providing cellular therapy to facilitate cardiac regeneration following myocardial ischemia, a condition that develops suddenly and can cause severe damage.**

METHOD

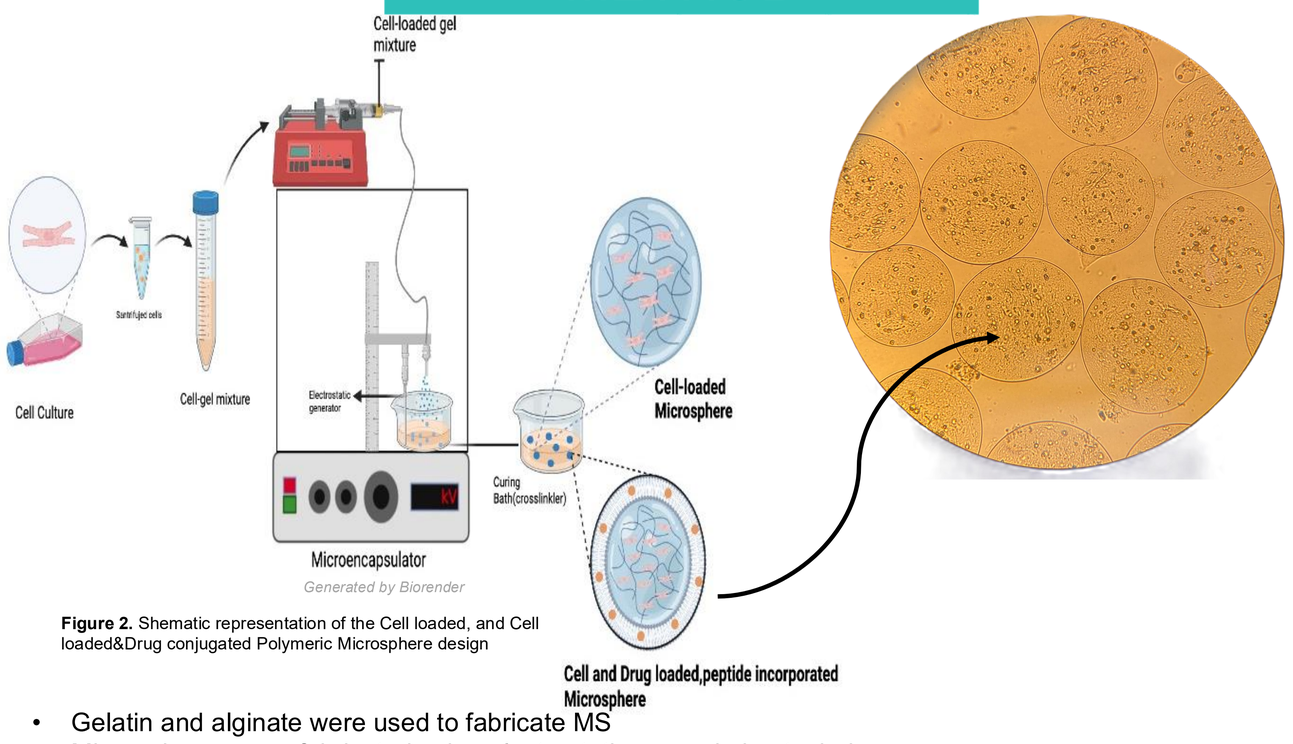

Figure 2. Shematic representation of the Cell loaded, and Cell loaded&Drug conjugated Polymeric Microsphere design

- Gelatin and alginate were used to fabricate MS
- Microspheres were fabricated using electrostatic spray drying technique
- Morphological analyses were performed using Scanning Electron Microscopy(SEM)
- Chemical structures were analyzed by Fourier Transform Infrared Spectroscopy(FT-IR)
- WLSEAGPVVTVRALRGTGSW peptide was synthesized to provide cell adhesion inside the MS
- The antioxidant drug α-lipoic acid was conjugated with gelatin and loaded with cell-encapsulated MS, which contribute to regeneration by reducing oxidative stress of cardiomyocytes activated in a hypoxic environment after MI.

RESULTS & DISCUSSION

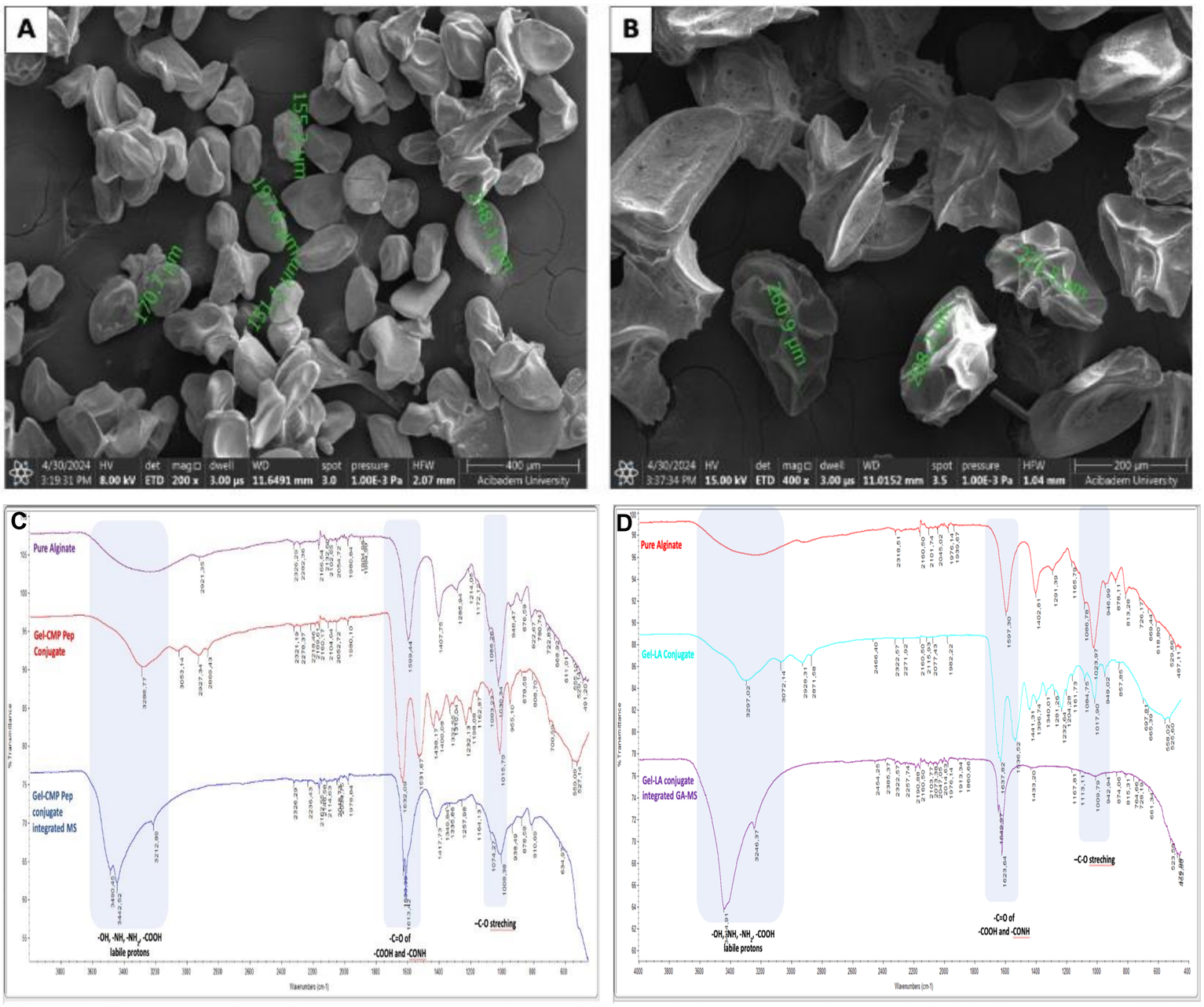

Figure 3.SEM images of the alginate microspheres including **a)** 0.1(w/v) %Gel-LA and **b)** 0.1(w/v) % Gel-CMP conjugates **c.)**FT-IR spectras of Pure Alginate, Gel-LA conjugate, and Gel-LA conjugate integrated MS, and **d)** Alginate, Gel-CMP Peptide Conjugate, and Gel-CMP Pep conjugate integrated MS

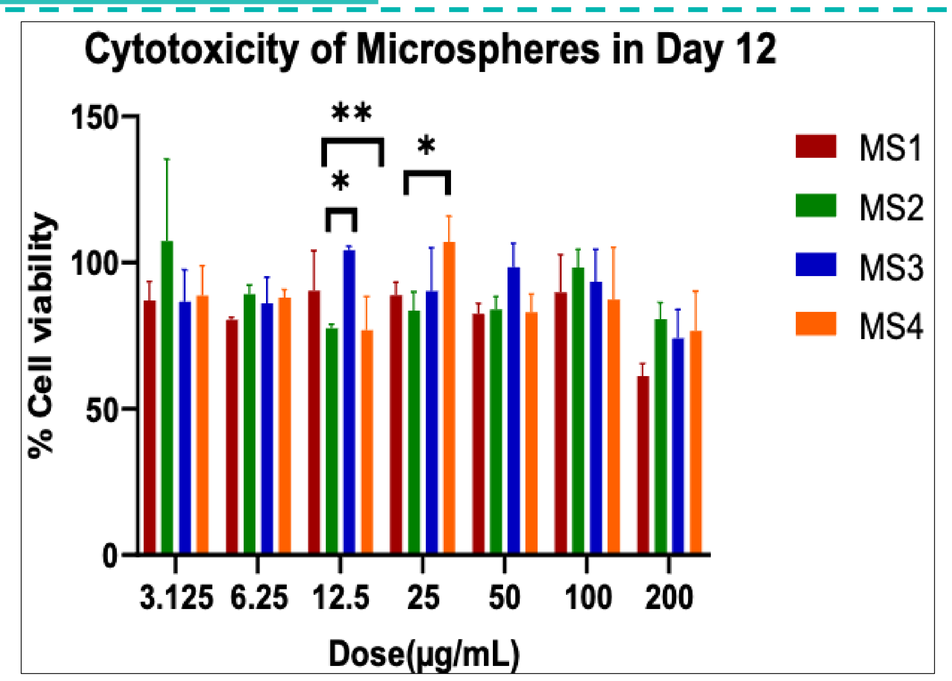

Figure 4. a) Dose dependent cytotoxicity of MS1,MS2,M3, and MS4 on day 12

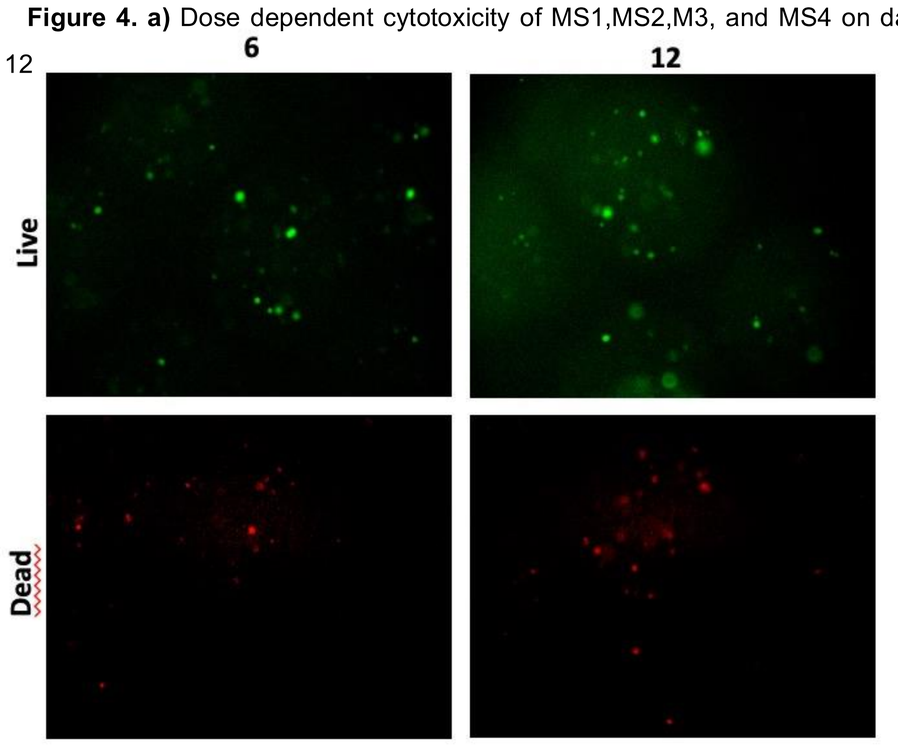

Figure 5. b) Fluorescence images of live/dead staining for H9C2 rat cardiomyocytes in the MS1 on days 6 and 12 (scale bar;300 mµ,10X)

CONCLUSION AND OUTLOOK

➢ Controlled drug release and cellular therapy platform were developed with the integration of gel-CMP pep conjugate to treat the ischemic heart muscle.
➢ The cell adhesion peptide was used to provide better-adhesion and induce apoptosis for the cardiac regeneration. Since the lipoic acid has antioxidant properties, it is accepted one of the strongest oxidation regulators.
➢ In the future, the combination of peptide and drug with the microspheres can be evaluated as promising candidates to contribute and expedite regenerate damaged heart muscle after the Myocardial Ischemia.

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