Title: Modulation of Gelatine Hydrogel Properties by Introducing Zwitterionic Interactions and Novel Chemical Crosslinking Strategies.

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In recent years, hydrogels have been a considerable interest for biological and biomaterial applications due to their high-water content which mimics the interstitial tissue environment, ensures high diffusive permeability and provides biomimetic mechanical strengths. Fabrication of implantable scaffolds that can host cells is rising. These scaffolds are made by bioactive and biocompatible biopolymers which can be proteins (collagen, elastin) or carbohydrate (hyaluronic acid) and can be found in the extracellular matrix of the human body. Hydrogels are used as scaffolds for tissue engineering, temporary supports for cells and vehicles for drug delivery systems. However, their use has been severely limited because of their capacity of swelling under physiological conditions which can deteriorate the mechanical properties and the shape of the implant. Swelling effect is based on the difference in osmotic and elastic pressure.

In the present thesis, some experiments have been carried out to study the properties of gelatine sulfobetaine (compound to study) and gelatine hydrogels. Swelling behaviour test in aqueous media was carried out determining how much these gels swell; solid content test to ensure that the theoretical value is the same as the experimental one, then prove that all possible crosslinks are formed and the excess of DMTMM is diffused out properly; amplitude sweep using a rheometer to obtain mechanical parameters such as storage modulus, LVR (Limit Viscoelastic Region) and yield strength. Then, results obtained for GSB were compared to the ones for gelatine. The amines of the protein were modified and, consequently, blocked for chemical crosslinking and providing more physical interactions involving the sulfobetaine functional groups. The carboxylic acid functional groups of gelatine or GSB were further chemically crosslinked using ethylene diamine. The resulting GSB hydrogels were found to be shrinking which can result in potentially strong hydrogels.

It is confirmed from the experimental data that with the rise of polymer concentration in gel and the rise of chemical crosslinks, the equilibrium swelling ratio decreases, and storage modulus increases. The formation of a peptide assembly makes a more compact hydrogel which has less space to accept water, then avoids the swelling behaviour.

In conclusion, GSB hydrogels could potentially be more useful in certain biological applications compared to gelatine.