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Optimization of thermally and enzymatically cross-linked gelatin films properties for drug delivery

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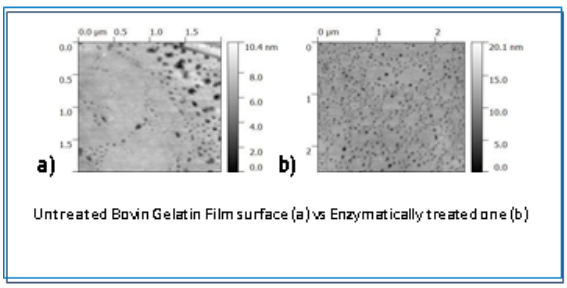
Our study investigates the influence of thermal1 and enzymatic2 crosslinking methods on the mechanical, thermal and physiochemical properties3 of gelatin which is known for its good properties in pharmaceutical application namely as a media of drug delivery4.

Initially, focus is given first to thermal crosslinking optimization in terms of temperature and heating time.It is found that, in a specific range of these parameters, this treatment decreases the surface polarity and the hydrophilicity of the film. The films treated during less than 5 hours at 150°C exhibited a decrease in water absorption rate measured by Goniometry (~0.13 µL/min) comparing to untreated films (~0.18 µL/min) and films treated over night (~0.33 µL/min) (The thickness of the film is 50 µm and the volume of the water drop deposited is 3 µL). Differencial scanning calorimetry showed decrease in crystallinity after thermal treatment which can be explained by an increase of cross-linking bridges number favorising an amorphous structure. The polymer became insoluble in aqueous medium at 37°C. Swelling capacity is reduced and contact angle is increased.Tensile testing showed an increase in Young's Modulus of the film after thermal crosslinking, thus, enhanced mechanical stability.

We have also started systematic study of enzymatic crosslinking by mTransglutaminase mTG. The gelatin films enzymatically crosslinked were obtained by mixing 4 mL of mTG (10%) with 100 mL of bovin gelatin solution (5%) prepared in deionized water. The surface of enzymatically crosslinked gelatin films observed by AFM showed a less surface roughness (0.98 nm) comparing to thermally crosslinked matrix (1.2 nm) with relief form (hollows). Untreated surfaces seem to present the lowest roughness (0.67 nm).



Untreated Bovin Gelatin Film surface (a) vs Enzymatically treated one (b)

Recent Publications

1. Jin et al. 2018. Effects of Thermal Cross-Linking on the Structure and Property of Asymmetric Membrane Prepared from the Polyacrylonitrile. Polymers,10;529.
2. Long et al. 2017. Preparation and characteristics of Gelatin sponges crosslinked by microbial transglutaminase. PeerJ, 5 ; 3665.
3. Chetouani et al. 2014. Physicochemical characterization of Gelatin-CMC composite edible films from Polyion-Complex Hydrogels. J.Chil.Chem.soc, 59 ;1.

4. Foox et al.2015. Review : Drug delivery from gelatin-based systems. Expert Opinion on Drug Delivery, 12:9, 1547-1563.

Biography

I'm a PhD student at the Institute of Materials Science of Mulhouse IS2M. I have a background in chemical engineering, materials and surface functionalization. Currently, I'm working on a project devoted to the development of a novel approach of chronomodulated therapy which takes into account the circadian biorythm of the human body. The release of drug will be programmed via complex spatial distribution of the drug in the biopolymer capsules.

Contributors :

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