MISCIBILITY AND BIOCOMPATIBILITY OF *O,O*-DILAUROYL CHITOSAN/PLLA COMPOSITES

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1 Introduction

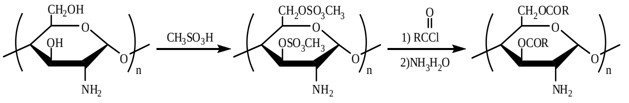
The research and development of tissue engineering in medicine has attracted polymer scientists and the likes in pursuit of new biomaterials as scaffold. Both chitosan and PLLA are well-known biomaterials[1,2].Chitosan and its derivatives possess excellent bioactivity, but less flexibility in regulating the mechanical and processing properties. However, PLLA has contrary properties to chitosan and its derivatives. Blending two polymers is an approach to develop new biomaterials exhibiting combinations of properties that could not be obtained by individual polymers.

In this work, a chitosan derivative *O,O*－dilauroyl chitosan (OCS), which can be soluble in chloroform, was synthesized by the reaction of chitosan and lauroyl chloride via methanesulfonic acid. OCS/PLLA composites have been prepared by solution-casting approach. The remained amino groups in OCS could form hydrogen-bond interactions with ester groups of PLLA, which is a potential driving force to make OCS/PLLA composites miscible. In additional, OCS can improve the cell affinity of PLLA dues to the bioactive amino groups in the main chain of OCS. The main objective of this research is to investigate the miscibility and biocompatibility of OCS/PLLA composites in order to explore novel biomaterials.

2 Experimental

2.1 Materials

OCS was facilely synthesized by chitosan and lauroyl chloride according to the method of previous reported by Nishi [3], the synthesis route as shown in Scheme 1.



Scheme 1. The synthesized route for OCS, R=$C_{11}H_{23}$.

PLLA with moderate molecular weight (M_W = 50kD) was obtained from Shandong Medical Appliance Institute.

2.2 Preparation of OCS/PLLA composites

Various composite films were prepared by solution casting from $CHCl_3$.

2.3 Miscibility of OCS/PLLA

The miscibility and hydrogen-bond interactions between OCS and PLLA have been studied by FTIR, TGA, DSC and WAXD.

2.4 Biocompatibility of OCS/PLLA

Biocompatibility of OCS/PLLA composite was investigated by NHI 3T3 cell adhesion ratio and MTT assays.

3 Results and Discussion

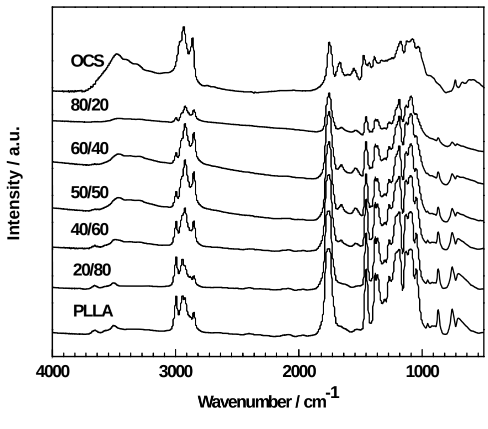


Fig. 1. FTIR spectra of OCS, PLLA and their composites.

FTIR experiments (Fig. 1.) indicate that the wavenumbers of amino stretching band of OCS and hydroxide stretching band of PLLA in the blend films have a red-shift change compared with both pure materials, which means that the hydrogen-bond interactions exist between OCS and PLLA in the blend systems. Furthermore, The ratio between the intensity of the crystalline peak to that of the amorphous peak for composites is found to decline compared to that of the pure PLLA film and to be decreased with increasing OCS content.

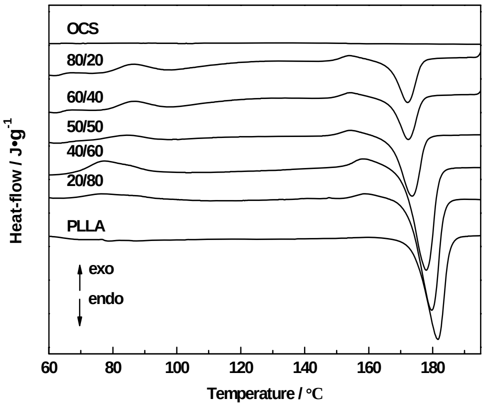


Fig. 2. DSC curves of OCS, PLLA and their composites.

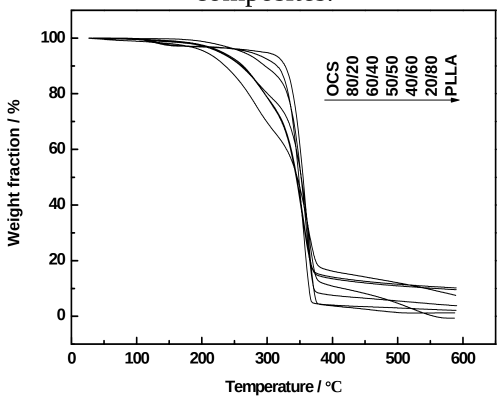


Fig. 3. TGA curves of OCS, PLLA and their composites.

Depressions of the crystallinity and T_m of PLLA were observed with increasing OCS content in the composite films. Moreover, a new exothermic peak around 80~90 ℃ was observed in DSC curves(Fig. 2.). TGA analytical results (Fig. 3.) confirm that the thermal stability of composite films is higher than that of OCS alone. WAXD patterns (Fig. 4.) show that the crystal peaks of PLLA at 2θ=16.7°, 19.1° shift to lower angle, and the diffraction peaks become weaker and broader obviously in the blend films with increasing OCS content, even disappear when OCS content reaches to 60%. FTIR, DSC, TGA and WAXD indicates the same result that strong hydrogen-bond interactions existed between OCS and PLLA, which is a potential driving force to make the composites miscible. Biocompatibility of PLLA, OCS/PLLA composite and TCPS was evaluated by cell adhesion ratio and cell viability (MMT assays) to NHI 3T3 in vivo. Both of cell adhesion ratio (Fig. 5.) and cell viability (Fig. 6.) results show that the cell affinity of OCS/PLLA composite is better than PLLA film. OCS/PLLA composite is a excellent biomaterial.

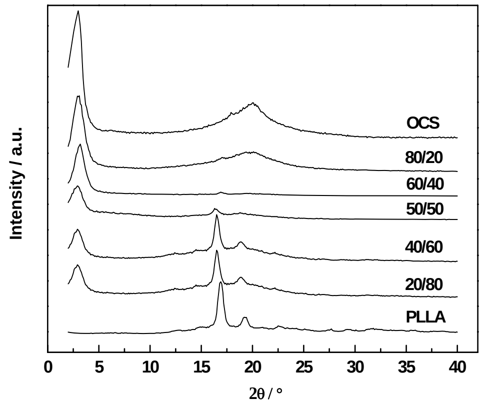


Fig. 4. WAXD patterns of OCS, PLLA and their composites.

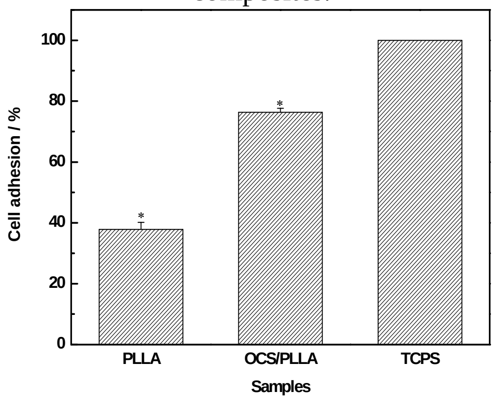


Fig. 5. NHI 3T3 cell adhesion on PLLA, OCS/PLLA composite and tissue culture plates.

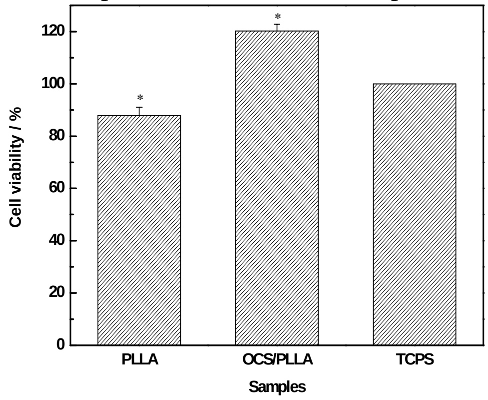


Fig. 6. NHI 3T3 cell viability on PLLA, OCS/PLLA composite and tissue culture plates.

References

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