Advanced Chitosan Composite Membranes for Skin Tissue Regeneration, Repair and Therapy

Simona Salerno[1], *Antonino Mazzaglia*[2], *Loredana De Bartolo*[1]

[1] Institute on Membrane Technology, National Research Council of Italy (CNR-ITM),
Via P. Bucci 17/c, 87036 Rende (CS), Italy
[2] Institute for Nanostructured Materials, National Research Council of Italy (CNR- ISMN), URT of Messina
Viale F. Stagno D'Alcontres, 98168 Messina, Italy

s.salerno@itm.cnr.it

Nanostructured polymeric membranes represent appealing biomaterials for tissue engineering and regeneration. Specific membrane properties provide the biochemical stimuli and mechanical support able to boost cellular adhesion, proliferation and differentiation. Engineered biodegradable chitosan membranes, in combination with human skin cells, have been successfully created as skin models, recapitulating the natural milieu of the in vivo skin layers [1-3]. The membrane porous structure, in addition, act as a protective barrier for skin damages, ensuring oxygenation and repair. Among advanced membrane design strategies, the membrane loading with bioactive molecules emerge as a further challenging approach to trigger or modulate biological processes, which are required for skin tissue regeneration, repair, and therapy.

Innovative composite chitosan membranes, combining polymeric materials with bioactive molecules, will be presented in this work as advanced instructive biomaterials for skin tissue engineering and repair.

Bioactive molecules, with a wide range of pharmacological activities, including anti-oxidant, anti-inflammatory and wound healing properties, have been incorporated in the microporous structure of the chitosan membrane, as water-soluble inclusion complexes with a β-cyclodextrin, or by using mesoporous silica nanoparticles [4], respectively. The physical-chemical and morphological-structural properties of the composite membranes favoured the adhesion and growth of human keratinocytes, providing biomimetic cues to facilitate epidermal maturation. The protective effect of the incorporated and released biomolecules from the composite membrane have been assessed in the epidermal membrane constructs. Moreover, a composite chitosan membrane with a photosensitizing nanosystem, based on a cyclodextrin/porphyrinoids assemblies, has been developed as a photosensitizing biomaterial with photoantimicrobial efficacy, opening new insight for skin disease treatments with photodynamic therapy.

These achievements represent an attractive tissue engineering approach for the creation of advanced composite membranes that incorporate bioactive molecules, useful in skin regeneration processes, or as topical patches for drug delivery, photodynamic therapy and skin repair.

References

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