New generation of polymeric wound dressings functionalized with immunoregulatory antimicrobial peptides accelerate tissue regeneration and protect against infections

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Abstract

Medical textiles are one of the most rapidly expanding sectors in the technical textile marketing, and wound dressing manufacture and design is possibly its most important segment.

In the past, traditional dressings were used to simply manage wounds. Modern dressing technology has evolved considerably in the last 50 years and is now based on the principle of creating an optimal environment, in which accelerating wound healing, tissue regeneration, and preventing infections are the main goals. Wound dressings are among the fastest growing products in the world. In 2016 the economical burden associated with these products was estimated at ≈ 33.1 b€, increasing 5.3% over past years. Hence, the urgency for more effective, target-directed and faster solutions for both acute and chronic wound care.

Typically, acute wound healing is a well-organized process that evolves and ends in a predictable amount of time. Conversely, chronic wounds are a result of gradual tissue degradation. These are often characterized by a defective matrix and cell debris impair healing, high bacteria counts, prolonged inflammation and moisture imbalance. A collection of expensive and individualized treatments, i.e. mechanical debridement, administration of antibiotics and anti-inflammatory agents, use of appropriate dressing and application of drug therapies, is applied to treat each symptom revealed by chronic wounds. Antimicrobial dressings that combine both dressing and drug in their formulation have been suggested as potential strategies to treat chronic wounds and prevent their evolution. Lately, in view of the quick rising of antibiotic-resistant pathogens, antimicrobial peptides (AMPs) that display broad spectrum of activity and act rapidly at multiple sites within microbial cells have been described as next generation agents that both accelerate healing and prevent microbial colonization. Considering these facts, we proposed to engineer polymeric micro and nanofibrous dressings, in the form of mats, functionalized with AMPs endowed with immunoregulatory properties. The goal was, therefore, to create a single therapy formulation, which integrates biocompatible polymers and AMPs with an active role in the different phases of wound healing, that act on all barriers to acute and chronic wound care. The antimicrobial performance of these new generation dressings was tested against *Staphylococcus aureus*, *Staphylococcus epidermidis* and

Escherichia coli bacteria, the most commonly found in hospital environments. Their hemocompatibility was also established. Preliminary data revealed the stability of the functionalized micro and nanofibers. Biological testing is ongoing.