Elbadawy A Kamoun, Pharmaceut Reg Affairs 2017, 6:1(Suppl)
DOI: 10.4172/2167-7689-C1-025

PVA-composite membranes for biomedical applications: A review of blended polymers

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A series of excellent poly(vinyl alcohol) (PVA)/polymers blend hydrogel membranes were reviewed using different crosslinking types to obtain proper polymeric dressing materials, which have satisfied biocompatibility and sufficient mechanical properties for wound dressing application. The importance of biodegradable–biocompatible synthetic polymers such as; PVA, natural polymers such as; alginate, starch, and chitosan or their derivatives has grown significantly over the last two decades due to their renewable and desirable biological properties. The properties of these polymers for pharmaceutical and biomedical application needs have attracted much attention. Thus, a considered proportion of the population need those polymeric medical applications for drug delivery, wound dressing, artificial cartilage materials, and other medical purposes, where the pressure on alternative polymeric devices in all countries became substantial. The review explores different polymers which have been blended previously in the literature with PVA as wound dressing blended with other polymeric materials, showing the feasibility, property change, and purpose which are behind the blending process with PVA. The wet-retentive dressings have been chosen previously based on the type of wound-shape. Conversely, polymeric hydrogel membrane dressings were found currently a convenient for any wound and burn, regardless the wound-shape. The first generation of membranes dressings is based on natural polymers, which are among the core topics intensively discussed in literatures. Biopolymers (e.g. chitosan, glucan, alginates, and hyaluronan) are more efficient as a wound-healing accelerator than synthetic polymers. Interestingly, the wounds covered with biopolymers, e.g. chitosan-based dressings showed fast healing rate and scarless healing, which are similar to those of normal skin. The second generation of dressings is based on the combination between biopolymers and synthetic ones using favorable physical crosslinking method that is a convenient for healing process. PVA the most frequent and versatile synthetic polymer was blended with either biopolymers or synthetic ones for wound dressing fabrication. PVA-biopolymer composite membranes exhibited better biological and antimicrobial activities than those composite with synthetic polymers, mainly PVA-chitosan and PVA-alginate membranes. Moreover, PVA-biopolymers composite membranes containing healing agents (e.g. Aloe vera, PEG, sterculia /Arabic gums) or antibiotics (e.g. sod. ampicillin or gentamicin) suggested being typical dressings for acute and chronic wounds. Some polymers like hydroxypropyl methylcellulose were added into nanofibers to keep high water retention and the moist environment. The third generation of dressings is based on PVA-nanoparticles and composite membranes were exploited to achieve the features of polymer and nanofillers for improving the performance of dressings for faster healing rate, pain relieving role, and easier removal. It is elaborated that the incorporation low content of ZnO or silver nanoparticles promoted feasibly the biological activity and microbial resistance of PVA-composite membrane. Graphene-based membrane dressings showed a surprised resistance against Gram negative bacteria. Finally, it have decided that natural polymers based dressings have outperformed synthetic polymers, while additives were incorporated to accelerate the healing or improve the mechanical potential, which were lately found advanced therapeutic impact as wound dressings.

Biography

Elbadawy A Kamoun (PhD Assoc. Prof.) received his PhD in Macromolecular Chemistry at the Braunschweig University of Technology (TU-BS) in February 7th, 2011 (Braunschweig, Germany). He obtained four Post-doctoral fellowships in 2012, 2014, 2016 from Institute for Technical Chemistry (TU-BS, Germany) and in 2013 from Dep. of Macromolecular Sciences, Fudan University in Shanghai, P R China, respectively. In April 3rd, 2016, he got promoted as Associate Professor at Polymeric Materials Res. Dep., SRTA-City, Egypt. His main interests are in polymeric membranes, for biomedical applications, wound dressings and for fuel cells, hydrogels, polymeric materials for electronic packaging, and photopolymerization.

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