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Formulation and characterisation of deferoxamine nanofiber as potential wound dressing for the treatment of diabetic foot ulcer

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Abstract

Diabetic foot ulcer (DFU) is often associated with the risk of non-traumatic lower extremity amputations in diabetic patients. Wound dressing with the active therapeutic agent(s) would be necessary to effectively manage the chronic condition of DFU. Deferoxamine (DFO) has been reported as a potential therapeutic agent in improving the wound healing process by regulating the expression and increasing the stability of hypoxia-inducible factor-1α (HIF-1α). Concurrently, polymeric nanofiber mats offer great potential for delivering therapeutic agents to wound owing to their high surface area to volume ratio and high porosity. Therefore, this study was aimed to develop a biomaterial-based nanofibrous wound dressing containing DFO as a novel platform to increase angiogenesis at the wound environment for rapid healing. A DFO-loaded bilayer nanofiber mat was formulated using chitosan, sodium alginate, and polyvinyl alcohol using electrospinning method. The effects of three independent parameters on nanofibers morphology were investigated using Box-Behnken statistical design. The fabricated bilayer electrospun fiber matrices had displayed the criteria of an ideal wound dressing with a high swelling degree of 594%, sufficient water vapour transmission rate (427.49 g/m^2•day), high entrapment efficiency (98%), sustained drug release up to 48h, and zone of inhibition against Gram + ve (0.79 ± 0.07 cm^2) and Gram –ve (0.95 ± 0.04 cm^2) organisms. The bilayer nanofiber mat was also found to be non-cytotoxic and the *in vitro* scratch test revealed wound healing potential, which implied its promising role as wound dressing tool to provide efficient treatment against DFU.