In vitro molecular study of wound healing using biosynthesized bacteria nanocelluse/silver nanocomposite assisted by bioinformatics databases

ABSTRCT

Background: In recent years, bacterial nanocellulose (BNC) based nanocomposites have been developed to promote healing property and antibacterial activity of BNC wound dressing. Molecular study can help to better understanding about interaction of genes and pathways involved in healing progression.

Objectives: The aim of this study was to prepare bacterial nanocellulose/silver (BNC/Ag) nanocomposite films as ecofriendly wound dressing in order to assess their physical, cytotoxicity and antimicrobial properties. The in vitro molecular study was performed to evaluate expression of genes involved in healing of wounds after treatment with BNC/Ag biofilms.

Study design, materials, and methods: Silver nanoparticles were formed by using Citrullus colocynthis extract within new isolated bacterial nanocellulose (BNC) RM1. The nanocomposites were characterized using X-ray diffraction, Fourier transform infrared, and field emission scanning electron microscopy. Besides, swelling property and Ag release profile of the nanocomposites were studied. The ability of nanocomposites to promote wound healing of human dermal fibroblast cells in vitro was studied. Bioinformatics databases were used to identify genes with important healing effect. Key genes which interfered with healing were studied by quantitative real time PCR.

Results: Spherical silver nanoparticles with particle size ranging from 20 to 50 nm were synthesized and impregnated within the structure of BNC. The resulting nanocomposites showed significant antibacterial activities with inhibition zones ranging from 7±0.25 to 16.24±0.09 mm against skin pathogenic bacteria. Moreover, it was compatible with human fibroblast cells (HDF) and could promote in vitro wound healing after 48h. Based on bioinformatics databases, the genes of TGF-β1, MMP2, MMP9, CTNNB1, Wnt4, hsa-miR-29b-3p and hsa-miR-29c-3p played important role in wound healing. The nanocomposites had an effect in expression of the genes in healing. Thus, the BNC/Ag nanocomposite can be used to heal wound in a short period and simple manner.

Conclusion: This eco-friendly nanocomposite with excellent antibacterial activities and healing property confirming its utility as potential wound dressings.

Keyword: Citrullus colocynthis; Bacterial nanocellulose; Bioinformatics study; Gene expression; Molecular study; Wound healing