Developing antibacterial wet-laid alginate fibers as wound dressıng

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Abstract: Wound management has been known as an important challenge for society since it has a major financial burden. As wound dressing plays a vital role in wound healing process, this issue has been investigated for years. The aim of this study is the production of an Alginate-based antibacterial fibrous wound dressing coated by silver nanowires (AgNWs).

Alginate is a non-expensive, biocompatible, biodegradable and linear polysaccharide that can produce fibers. Additionally, this material has the ability to form hydrogel, while integrating with cations like calcium [1], [2]. Alginate hydrogels contain a large amount of water content allowing them to provide moist environment to the wounded area. Alginate have been utilized in wound healing for several years [3], [4]. Furthermore, fibrous structures enhance the swelling behavior of the dressing and in this way it can absorb wound exudates and it can also easily be removed from wound beds [6],[7]. Due to all mentioned characteristics, alginate has been widely applied in wound dressings.

For this purpose, wet spinning method was used for fabrication of alginate fibers. Wet spun calcium (Ca)-alginate fibers were produced via coagulating sodium (Na)-alginate solution in the aqueous solution of $CaCl_2$. Moreover, by utilizing wet laying method (*See Fig. 1*), nonwoven matrix was developed. Finally, AgNWs were synthesized using polyol method and then disposed onto a nonwoven alginate matrix for antibacterial activity [7].

The properties of prepared materials were studied with scanning electron microscopy (SEM), antibacterial activity, swelling behaviors and gel fraction of samples were investigated.

According to this study, AgNWs coated wet-laid alginate prevented bacterial growth for both gram-positive and gram-negative bacteria. On top of that, porous structure facilitates gas circulations, therefore promoting cell growth and wound healing.

Keywords: *Alginate, wet-laid, wet spinning, wound dressing.*

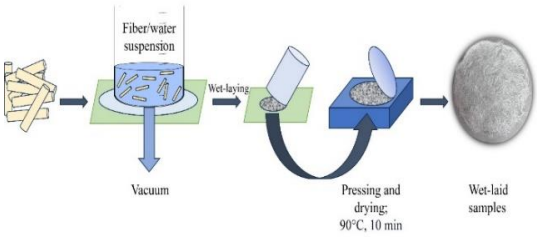

Figure 1. Illustration of the wet-laid

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REFERENCES

[1] L. Wang *et al.*, “A Physically Cross-Linked Sodium Alginate–Gelatin Hydrogel with High Mechanical Strength,” *ACS Appl. Polym. Mater.*, vol. 3, no. 6, pp. 3197–3205, Jun. 2021, doi: 10.1021/acsapm.1c00404.
[2] B. Balakrishnan, M. Mohanty, P. R. Umashankar, and A. Jayakrishnan, “Evaluation of an in situ forming hydrogel wound dressing based on oxidized alginate and gelatin,” *Biomaterials*, vol. 26, no. 32, pp. 6335–6342, Nov. 2005, doi: 10.1016/j.biomaterials.2005.04.012.
[3] A. R. Abbasi *et al.*, “Bioinspired sodium alginate based thermosensitive hydrogel membranes for accelerated wound healing,” *International Journal of Biological Macromolecules*, vol. 155, pp. 751–765, Jul. 2020, doi: 10.1016/j.ijbiomac.2020.03.248.
[4] “Synthetic polymeric biomaterials for wound healing: a review | Progress in Biomaterials.” Accessed: Dec. 25, 2023. [Online]. Available: https://link.springer.com/article/10.1007/s40204-018-0083-4
[5] M. A. Fonder, G. S. Lazarus, D. A. Cowan, B. Aronson-Cook, A. R. Kohli, and A. J. Mamelak, “Treating the chronic wound: A practical approach to the care of nonhealing wounds and wound care dressings,” *Journal of the American Academy of Dermatology*, vol. 58, no. 2, pp. 185–206, Feb. 2008, doi: 10.1016/j.jaad.2007.08.048.
[6] “A structured approach to the selection of dressings.” Accessed: Feb. 07, 2024. [Online]. Available: http://www.worldwidewounds.com/1997/july/Thomas-Guide/Dress-Select.html
[7] R. S. Jones, R. R. Draheim, and M. Roldo, “Silver Nanowires: Synthesis, Antibacterial Activity and Biomedical Applications,” *Applied Sciences*, vol. 8, no. 5, Art. no. 5, May 2018, doi: 10.3390/app8050673.