# 應用 β-葡聚醣/生物聚合物複合水凝膠促進傷口癒合

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## 大綱

一、前言

二、高壓加工誘導不同分子量組成的燕麥 β-葡聚醣混合凝膠的特性與形成機制

三、使用含有 β-葡聚醣的傷口癒合複合水凝膠

四、海藻酸鹽-幾丁聚醣水凝膠貼片結合 β-葡聚醣奈米乳液的抗菌應用

五、結論

## 摘要

傷口癒合是一個複雜的過程，涉及各種細胞外基質成分以不同方式參與三個階段：發炎、細胞增殖和組織重塑。因 β-葡聚醣具有抗氧化、抗發炎、保濕、抗感染特性等特性，並對多種革蘭氏陽性、陰性菌表現出潛在的抗菌活性，因此 β-葡聚醣是一種合適的傷口癒合劑的選擇。本次報告的目的為探討應用 β-葡聚醣與生物聚合物製備的複合水凝膠應用於促進傷口癒合。燕麥 β-葡聚醣使用超高壓技術(High Pressure Processing，HPP)誘導不同分子量、比例的混合凝膠性能的影響，在 500 MPa 下只需要 8%的 β-葡聚醣。從埃及燕麥萃取出較高含量的 β-葡聚糖，結合使用凍融循環製成不同聚乙烯醇（Polyvinyl alcohol, PVA）-多醣水凝膠，使用陰離子及親水性較高聚合物製備的水凝膠顯示出較佳的膨脹率、生物黏附性，並對於含有羥乙基纖維素(Hydroxyethyl cellulose,HEC)(F7)和羧甲基纖維素鈉(sodium carboxymethyl cellulose ,NaCMC)(F9)的兩種進行了抗發炎與傷口癒合的體內評估，F7 的癒合效果(99%傷口縮小率)比 F9 更佳。當海藻酸鹽和幾丁聚醣這兩種物質混合時，會透過離子鍵形成穩定的結構，並透過 W/O 技術製備奈米乳液，製備出平均尺寸為 200 nm 的 β-葡聚糖奈米乳液。進行 MTT 分析以判斷細胞毒性，結果證實了水凝膠沒有毒性。綜合上述三篇的研究結果，β-葡聚醣混合凝膠的流變學和質構特性隨著濃度和壓力的增加而增加，不會造成結構的破壞且與生物聚合物的結合也可抑制細菌的生長活性，這些特性都有利於傷口癒合水凝膠的應用。

# Application of Beta-Glucan/Biopolymer Composite Hydrogel to Promote Wound Healing

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## Outline

**1.** Introduction
2. Characterization and formation mechanism of oat β-glucan hybrid gels with different molecular weight compositions induced by high pressure processing
3. Use of wound healing composite hydrogel containing beta-glucan
4. Antimicrobial Application of Alginate-Geoglycan Hydrogel Patch Combined with β-Glucan Nano-Emulsion
5. Conclusions

## Abstarct

Wound healing is a complex process that involves various extracellular matrix components that participate in different ways in three phases: inflammation, cell proliferation and tissue remodeling. β-Glucan is a suitable choice as a wound healing agent because of its antioxidant, anti-inflammatory, moisturizing, and anti-infective properties, and because of its potential antimicrobial activity against a wide range of gram-positive and gram-negative bacteria. The objective of this report is to investigate the application of β-glucan with biopolymers in a composite hydrogel to promote wound healing. The use of oat β-glucan using HPP (High Hydrostatic Pressure) induced an effect on the performance of the gels with different molecular weights and ratios of the blends, requiring only 8% of β-glucan at 500 MPa. Higher levels of β-glucan were extracted from Egyptian oats and combined with a freeze-thaw cycle to produce different PVA-polysaccharide hydrogels. Hydrogels prepared using anionic and hydrophilic polymers showed better expansion rates, bioadhesion, and in vivo anti-inflammatory and wound-healing evaluations were performed on two types of hydrogels containing HEC (F7) and NaCMC (F9), and the healing efficacy (99%) was demonstrated in the case of F7. The healing effect of F7 (99% wound reduction) was better than that of F9. When the two substances, alginate and geopolysaccharide, were mixed, they formed a stable structure through ionic bonding, and nano-emulsions were prepared by W/O technology to produce β-glucan nano-emulsions with an average size of 200 nm. MTT analysis was performed to determine cytotoxicity, and the results confirmed that the hydrogel was not toxic. Taken together, the rheological and textural properties of the β-glucan hybrid gels increased with increasing concentration and pressure, did not cause structural damage and the combination with biopolymers inhibited the growth activity of bacteria, which are favorable for the application of wound healing hydrogels.

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