Study on Production of Bacterial Cellulose by Acetobacter xylinum WU1 and Antimicrobial Application of Bacterial Cellulo

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ABSTRACT

Bacterial cellulose (BC), which is synthesized and secreted by the gram negative bacterium, Acetobacter xylinum WU1, displays unique physical, chemical, and mechanical properties including a high crystallinity, a high water holding capacity, a well-developed surface area comprised of nanofibers, elasticity, mechanical strength, and biocompatibility. BC displays such special physicochemical characteristics, applications in the paper and food industries as well as in the medical field as an artificial skin and blood vessel substitute are expected.

Static batch fermentations for bacterial cellulose production were studied in carbon sources, nitrogen sources, pH, temperature, organic acid (citric acid, succinic acid and acetic acid), ethanol concentration (0-10%), acetic acid concentration (0-20%), sweet potato concentration (0-20 g/L) and aeration rate (0.5-2 L/min) in flask under 30°Cby A. xylinum WU1. Bacterial cellulose production from A. xylinum WU1was affected by various environmental factors, such as pH and temperature; initial pH5.5 and 30 °C were favorable for bacterial cellulose production. On the other hand, the experimental results showed that BC dried weight was maximum 3.7 g/L, when aeration rate was controlled at 1.5 L/min, glucose concentration was 20 g/L at pH 5.5 in 5L fermentor. Structural changes in never-dried, disintegrated bacterial cellulose by treatment with various alkali treatment and various drying process were examined. The pretreatmented/ treatmented bacterial cellulose were characterized by X-ray diffractometry (XRD), Fourier Transform Infrared spectroscopy (FTIR) and Field-emission scanning electron microscope (FE-SEM). In additionally, Hunter lab colour parameters were determined to assess the effect of different alkali treatments on the colour characteristics of the bacterial cellulose. The overall quality of the freeze dried membranes had higher ‘L’ values. On the other hand, alkali treatmented bacterial cellulose using NaOH and Na_2CO_3 with higher ‘L’ values 101.8 and 97.1, respective. The XRD patterns of freeze dried membranes obtained the with reduce in the relative intensity of plane diffraction. In contrast, air dried membranes with higher intensity. No crystallize difference directly caused by alkali treatment could be seen with XRD.

Bacterial cellulose was an interesting material for using as a wound dressing since it provides moist environment to a wound resulting in a better wound healing. But bacterial cellulose itself has no antimicrobial activity to prevent wound infection. To achieve antimicrobial activity, nano-silver were impregnated into bacterial cellulose by immersing bacterial cellulose in $AgNO_3$ solution. The formation of nano-silver was also evidenced by the scanning electron microscope. The dried nano-silver impregnated bacterial cellulose exhibited strong the antimicrobial activity against Escherichia coli(Gram-negative) and Bacillus subtilis (Gram-positive).

Keywords : Acetobacter xylinum、bacterial cellulose、nano-silver wound dressing、antimicrobial activity

Table of Contents

圖目錄

表目錄

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