Production of Bacterial Cellulose

by Acetobacter xylinum under Agitated Condition

Bong-Woo Chung*, Hyun-Chul Lee**, Eun-Mi Lee***, Myeong-Seok Ko**** and Byeong-Nam Park****

교반조건에서 Acetobacter xylinum에 의한 미생물 설탕로스의 생산

경 통우*・이 현철**・이 온미***・고 명석****・박 병남****

요 약

Acetobacter xylinum은 호기적인 조건에서 정지배양 하면 배양액 표면에서 얇은 막의 형태 (pellicle)로 3차원 망상조직의 설탕로스가 형성된다. 그러나 교반배양에서 진단력에 의해 설탕로 오스를 생성하지 못하는 cellulose-negative mutant(Cel')를 생성하는 생리적인 특성을 가지고 있 어, 교반배양시 생산성이 상당히 떨어진다. 산업적 측면에서 정지배양은 배양시간이 길며, 노동력이 많이 들기 때문에 비효율적이다. 따라서 본 연구에서는 교반배양에 적합한 균주를 선별하고, 교반배양 하에서 설탕로스 생산특성을 위해 살펴보았다.

Keyword : Bacterial cellulose, Acetobacter xylinum, Microbial cellulose production

1. Introduction

Cellulose, a linear 1,4-β-glucan, is the most abundant natural macromolecule on earth\(^1\), where it plays a crucial role in the integrity of plant cell wall. It is produced by photosynthesis yearly, mostly is used as raw material of paper.

Cellulose is also synthesized by bacteria, especially by the Gram-negative Acetobacter xylinum. Acetobacter strain produces a white gelatinous material (pellicle) on the surface of the liquid medium in a static culture system. In 1886, Brown first reported that the pellicle was composed of pure cellulose\(^2\). The cellulose

* 전북대학교 화학공학부 교수
** 한국대학교 전임강사
*** 우석대학교 강사
**** 전북대학교 대학원 석사과정
produced by *Acetobacter* strain is called bacterial cellulose. Plant and bacterial cellulose are of the same chemical constituency and molecular structure but bacterial cellulose possesses physical and chemical properties, such as strong mechanical properties, high degree of polymerization. It is composed of chemically pure celluloses without lignin, hemicellulose, and other substances, thus it can be purified more easily than natural cellulose\(^3\). At present, the utilization of these properties have been studied for several aspects of practical usage of bacterial cellulose. For example, an application for bacterial cellulose comes from the SONY Corporation, which uses cellulose produced by *A. xylinum* to make sensitive diaphragms for stereo headphones. Microbial cellulose is also available as food product called Nata in the Philippines\(^4\). Weyerhauser and Cetus Corporation have recently developed a strain *Acetobacter* that is capable of large-scale cellulose production under fermentative conditions with agitation\(^5\). The fibers produced termed “Cellulon” have a number of potential commercial applications such as binders for ceramic powders and minerals, thickeners for paint, ink, adhesives, and even foods. Another possible use for Cellulon is used as a paper coating because of its high purity. Also recently, it was reported that *Acetobacter* cellulose as a temporary skin substitute to protect tissue burned regenerates normal skin.

The static culture system is inefficient from the industrial point of view, because it requires not only a very long culture period but also labor-wasting. But cellulose productivity is decreased by the shear stress in agitated culture. One of the reasons for this decrease is considered to be the genetic instability and the gradual overgrowth of non-cellulose producer\(^6\)\(^7\).

As a result, Bio Polymer Research Co. isolated a high-cellulose-producing strain, *Acetobacter xylinum* subsp. *sucrofermentans* BPR 2001, in agitated culture. They developed a gluconate negative mutant from the parent strain and improved cellulose productivity.

In this study, we screened cellulose-producing strains suitable for agitated culture from traditional persimmon vinegar and estimated cellulose productivity in a shaking culture system, and during cellulose production. We examined the time course of the pH and gluconic acid level. To search optimum culture conditions, we examined an effect of agitation speed and various glucose concentrations.

### 2. Materials and Methods

#### 2.1 Bacterial Strains

The *Acetobacter xylinum* used in this study was isolated from persimmon vinegar by the Biochemical Engineering Lab. of Chonbuk National University.