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# Current Trends and Production of Bacterial Cellulose in Biomedical Engineering

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## Introduction

Bacterial cellulose is a distinctive biomaterial with significant potential in biomedical engineering. This article reviews the current state of BC production, its properties and its diverse applications within the field. We cover the methods used to produce BC, highlight its key characteristics and examine its various biomedical uses. Additionally, we discuss the challenges faced and future prospects for BC in biomedical applications. BC is produced by specific bacteria, predominantly *Acetobacter xylinum* and has attracted considerable attention in biomedical engineering due to its unique properties, including high purity, exceptional mechanical strength, biocompatibility and biodegradability. Its applications are broad, encompassing wound dressings, tissue engineering scaffolds, drug delivery systems and medical implants. BC is generated through the fermentation of *A. xylinum* in a nutrient-rich culture medium containing carbon and nitrogen sources. During this process, the bacteria produce cellulose, which forms a gel-like pellicle on the medium's surface. After harvesting, this pellicle is purified to yield BC, ready for various biomedical uses [1-3].

## Description

Several factors influence the yield and properties of Bacterial Cellulose (BC), including culture conditions, medium composition and bacterial strains. BC is known for its remarkable properties, which make it highly suitable for biomedical applications. It features a highly crystalline structure, contributing to its mechanical strength and biocompatibility. Its exceptional water retention capacity and oxygen permeability enhance its effectiveness as a wound dressing. Additionally, BC is non-toxic, biodegradable and exhibits low immunogenicity, making it safe for use in medical applications. The most extensively studied bacterial strain for BC production is *Gluconacetobacter xylinus*. The production process typically involves aerobic fermentation in a nutrient-rich medium containing glucose, peptone, yeast extract and other essential nutrients. Optimal production conditions include a pH range of 4-7, a temperature range of 25-30°C and a sufficient supply of oxygen. BC can be produced in two main types of cultures: static and agitated. In static cultures, BC forms a thick pellicle at the air-liquid interface, generally resulting in higher-quality BC with superior mechanical properties. In contrast, agitated cultures produce BC as small particles suspended in the medium, which is more suitable for large-scale production due to improved oxygen transfer and higher yields. To enhance BC production, various strategies have been implemented, including genetic engineering of bacterial strains, optimization of fermentation conditions and the use of alternative carbon and nitrogen sources. Genetic modifications, such as overexpressing cellulose synthase genes or knocking out competing metabolic pathways, have shown promising improvements. Additionally, utilizing agro-industrial byproducts, like molasses, fruit peels and corn steep liquor, as substrates can lower production costs and increase sustainability [4,5].

## Conclusion

Improved soil structure, enhanced water retention and efficient nutrient uptake significantly bolster plants' ability to withstand drought conditions. High soil salinity can stress plants by restricting their water absorption, but microbial compost fertilization can help mitigate this stress by improving nutrient availability and root health. Plants treated with microbial compost have also shown greater resilience to temperature extremes, with the root microbiome playing a crucial role in aiding plant adaptation to fluctuating temperatures. Research from drought-prone regions highlights that maize plants treated with compost tea exhibited increased drought tolerance compared to untreated controls. This enhanced resilience is attributed to the improvements in soil structure and water retention resulting from the compost treatment.

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## Conflict of Interest

There is no conflict of interest by author.

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