Bacterial cellulose – biosynthesis, properties and applications

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Cellulose is the most abundant earth biopolymer, recognized as the major component of plant biomass, and a representative of microbial extracellular polymers. An efficient producers of cellulose are acetic acid bacteria *Acetobacter xylinum.* Several different techniques for bacterial cellulose production have been reported so far some of which seem to demonstrate a potential tool for economic and commercial BC production: stationary culture, agitated culture, cultivation in the horizontal fermentors or cultivation in the internal-loop airlift reactors. The choice of a cultivation technique is strictly dependent on further biopolymer commercial destination. In the stationary culture conditions a thick, gelatinous membrane of bacterial cellulose is accumulated on the surface of a culture medium, whereas under agitated culture conditions cellulose can be produced in the form of a fibrous suspension, irregular masses, pellets or spheres. While stationary culture has been quite widely investigated and applied for production of some successful commercial cellulose products (*Nata de Coco*, transducer diaphragms, wound care dressing materials, etc.), agitated culture is still considered as a cultivation technique which is more suitable for the commercial production of BC mainly due to the higher production rates which potentially can be achieved. However, it is also well known that cellulose production in fermentors with continuous agitation and aeration encounters many problems, including spontaneous appearance of *Cel*$^-$ mutants (cellulose non-producers), which contributes to a decline in the polymer synthesis. Bacterial cellulose from *Acetobacter* strains displays unique physical, chemical and mechanical properties including high crystallinity, high water holding capacity, large surface area, elasticity, mechanical strength and biocompatibility. Among new commercial applications, BC has been shown to be very beneficial in the treatment of secondary and third degree burns. A clinical study has been performed on 34 patients. The BC wound dressing materials were directly applied on the fresh burn covering up to 9-18% of the body surface. The following diagnoses were considered: macroscopic observation of the wound and wound extract, epidermis growth, microbiological tests, and histopathological studies. BC appears to be one of the best materials to promote wound healing from burns. Factors for this success include but are not limited to the following: a moist environment for tissue regeneration; significant pain reduction; specific cellulose nano-morphology which promotes cell interaction and tissue re-growth; significant reduction of scar tissue formation; and, easy and safe release of wound care materials from the burn site during treatment. Microbial cellulose promises to have many new applications in wound care that extend beyond burn applications including, but not limited to, the following: surgical wounds, bedsores, ulcers, tissue and organ engineering.