Bacterial cellulose (BC) is a type of cellulose produced by bacteria in a glucose-based medium that has more advantages than plant cellulose. The production of cellulose powders, however, has the characteristics affected due to physical treatments; thus, the objective of this research was to produce BC powder for use in paper production. BC was produced by agitation with oxygen flow at various rotational speeds to obtain a fragmented BC phase. BC samples were dried by a spray dryer to produce powder for paper making. The characterization of BC powder and paper samples was done by Fourier transform infrared (FTIR) spectroscopy, thermogravimetric analysis (TGA), tensile strength, and scanning electron microscopy (SEM). The morphological results showed optimum BC was produced at 300 rpm rotation speed with a 405.2 g yield, while the FTIR spectrum confirmed that the material is a cellulosic compound. TGA characterization of the optimum sample displayed thermal stability at 330 °C in the thermal analysis. Among the variations in rotational speed, the 300 rpm sample led to the highest Young’s modulus value, 878 MPa, and the most improved surface morphology.