Production of Bioplastic by a Bacterium Isolated from Waste Treatment Facility (from Lignocellulosic Glucose, Abundant Sucrose, Byproduct of Biodiesel & Spent Coffee Grounds Extract)

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Plastics are indispensable in our daily lives, and are currently made from fossil resources. Due to the environmental problems and global warming, however, they need to be produced from renewable non-food biomass. The purpose of this study was to isolate from waste sludge a new bacterium capable of producing poly(3-hydroxybutyrate) [P(3HB)] and to examine its P(3HB) producing characteristics. One bacterium capable of producing P(3HB) was isolated, and was identified as Bacillus cereus through the 16S rRNA sequence analysis. Cultivation of the isolated B. cereus strain in nutrient broth supplemented with glucose allowed production of P(3HB) to 4.0% of cell dry weight (CDW). Then, the cells were cultured in nitrogen, potassium, and sulfur-limited media to examine the effect of nutrient limitation on P(3HB) production. Cells cultured in the nitrogen, potassium and sulfur limited conditions produced P(3HB) to 36.7% (highest content of 44.9%), 33.0% and 32.4% of CDW, respectively, which were 8-10 times higher than that without any limitation. Also, P(3HB) could be produced under nitrogen-limited condition from glycerol, crude glycerol, and sucrose to the contents of 2.6%, 2.4%, and 11.2% of CDW, respectively, but was not produced from xylose or lactose. Interestingly, P(3HB) could be produced for the first time from the carbohydrate extract of the spent coffee grounds containing mannose. P(3HB) could be purified from cells by solvent extraction and precipitation. Thus, the isolated B. cereus strain can efficiently produce P(3HB) from glucose (lignocellulosics), glycerol (biodiesel waste), sucrose (abundant), and mannose (spent coffee) under the nitrogen limited condition.