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The Combined Effect of Methane and Methanol on Growth and PHB Production in the Alphaproteobacterial Methanotroph Methylocystis Sp. Rockwell

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Abstract : Methane is a highly potent greenhouse gas mostly released through anthropogenic activities. Methane represents a low-cost and sustainable feedstock used for the biological production of value-added compounds by bacteria known as methanotrophs. In addition to methane, these organisms can utilize methanol, another cheap carbon source that is a common industrial by-product. Alphaproteobacteria methanotrophs can utilize both methane and methanol to produce the biopolymer polyhydroxybutyrate. The goal of this study was to examine the effect of methanol on polyhydroxybutyrate production in Methylocystis sp. Rockwell and to identify the optimal methane: methanol ratio that will improve PHB without reducing biomass production. Three methane: methanol ratios (4, 2.5., and 0.5) and three nitrogen source (ammonium or nitrate) concentrations (10 mM, 1 mM, and 0.1 mM) were combined to generate 18 growing conditions (9 per carbon source). The production of polyhydroxybutyrate and biomass was analyzed at the end of growth. Overall, the methane: methanol ratios that promoted polyhydroxybutyrate synthesis without reducing biomass were 4 and 2.5 and the optimal nitrogen concentration was 1 mM for both ammonium and nitrate. The physiological mechanism behind the beneficial effect of combining methane and methanol as carbon sources remain to be discovered. One possibility is that methanol has a dual role as a carbon source at lower concentrations and as a stringent response trigger at higher concentrations. Nevertheless, the beneficial effect of methanol and optimal nitrogen concentration for PHB production was confirmed, providing a basis for future physiological analysis and conditions for process scale-up.

Keywords : methane, methanol, methanotrophs, polyhydroxybutyrate, methylocystis sp. rockwell, single carbon bioconversions
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