BIOSYNTHESIS OF PRECURSORS TO ENERGETIC MATERIALS

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Microbial synthesis can offer an alternative to problematic chemical conversions. Two examples include 1,2,4-butanetriol (BT), which is the precursor to butanetriol trinitrate (BTTN) and phloroglucinol (PG), which is the precursor to 1,3,5-triamino-2,4,6-trinitrobenzene (TATB). Catalytic hydrogenation of malic acid requires elevated temperatures, elevated hydrogen pressures, and leads to a complex mixture of products from which BT is difficult to purify. Stoichiometric reduction of esterified malic acid employs sodium borohydride and leads to formation of multiple tons of borate salt byproducts for every ton of BT produced. By contrast, microbial synthesis of BT from xylose uses atmospheric pressure, temperatures not exceeding 37°C, and avoids generation of large quantities of salts as byproducts. Chemical synthesis of PG is similarly problematic. This multistep route uses TNT as the starting material, requires a stoichiometric oxidation employing carcinogenic chromium (VI), and generates large quantities of salts as byproducts. A microbial synthesis of PG has now been elaborated that enables this TATB precursor to be produced in a single step from glucose. Beyond BTTN and TATB, the use of microbial synthesis to produce precursors to other energetic materials will be discussed.