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Photochemical Synthesis of Methanol from Formaldehyde Using Alcohol Dehydrogenase Coupled with Photosensitization of Zinc Porphyrin

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Photochemical synthesis of methanol from formaldehyde was evaluated with alcohol dehydrogenase (ADH) from *Saccharomyces cerevisiae* and NAD^+ photoreduction by the visible light photosensitization of zinc tetraphenylporphyrin tetrasulfonate (ZnTPPS) in the presence of triethanolamine (TEOA) as an electron-donating reagent. Irradiation of a solution containing ZnTPPS, methylviologen (MV^{2+}), NAD^+, diaphorase (5 units) and TEOA in potassium phosphate buffer with visible light resulted in formation of NADH increasing with time. NADH was not formed in the absence of any one of the five components, TEOA, ZnTPPS, MV^{2+}, diaphorase and NAD^+. The reduction ratio of NAD^+ to NADH reached about 60% after 180 min irradiation. Irradiation of a solution containing formaldehyde, ZnTPPS, MV^{2+}, ADH, diaphorase and TEOA with visible light resulted in formation of methanol. The formaldehyde concentration decreased with formation of methanol. This result indicates that the photochemical synthesis of methanol from formaldehyde depends on ADH and NADH produced by the photosensitization of ZnTPPS. The concentration of methanol was 0.38 μmol·dm^{-3} after 3 h irradiation under conditions of ZnTPPS (1.0 μmol·dm^{-3}), MV^{2+} (0.1 mmol·dm^{-3}), NAD^+ (0.1 mmol·dm^{-3}), diaphorase (5 units), TEOA (0.3 mol·dm^{-3}), formaldehyde (16 μmol·dm^{-3}) and ADH (25 units).

Keywords: Photochemical methanol synthesis, Zinc porphyrin, Alcohol dehydrogenase,

Enzymatic synthesis

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