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Visible Light-induced Formic Acid Synthesis from HCO_3^- with Formate Dehydrogenase and Water-soluble Zinc Porphyrin

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Photochemical and enzymatic synthesis of formic acid was investigated from HCO_3^- with formate dehydrogenase (FDH) from *Saccharomyces cerevisiae* and reduced methylviologen (MV^{2+}) produced by the visible light photosensitization of zinc tetrakis(4-methylpyridyl) porphyrin (ZnTMPyP) in the presence of triethanolamine (TEOA) as an electron donating reagent. Irradiation of a solution containing TEOA, ZnTMPyP, MV^{2+}, $NaHCO_3$ and FDH in potassium phosphate buffer, with visible light resulted in formic acid production and HCO_3^- consumption. The optimum FDH activity was 20 units and the amount of formic acid and the yield of HCO_3^- to formic acid after 4 h irradiation were estimated to be 50 $\mu mol \cdot dm^{-3}$ and 5.0%, respectively.

Keywords: Formic acid synthesis, Zinc porphyrin, Formate dehydrogenase, Enzymatic synthesis