

Green oxidation of bio-lactic acid with H₂O₂

into Tartronic acid under UV irradiation

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EXPERIMENTAL SECTION

L(+)-Lactic acid, 90 wt% solution in water, Hydrogen peroxide(H₂O₂), for analysis, 30 wt.% solution in water, were purchased from Shanghai jingchun Biochemical Technology Co., Ltd, China, and were used for the photoreaction without further purification. 300 W high-pressure Hg lamp ($\lambda = 365$ nm, $I = 80$ W/cm²) was used as the light source.

Typical H₂O₂ photolytic procedure induced oxidation of lactic acid

Photochemical oxidation reactions were conducted under irradiation of a 300 W high-pressure Hg lamp with continuous stirring in a 200 mL Pyrex glass bottle under argon atmosphere. The lamp was cooled by water circulating through a Pyrex thimble. The typical reaction system contained 0.04 mol H₂O₂ and 0.1 mol lactic acid in 200 mL aqueous solutions. Before irradiation, the solution was deoxygenated with Ar purging for 30 min. After the reaction, the solution was analyzed by HPLC.

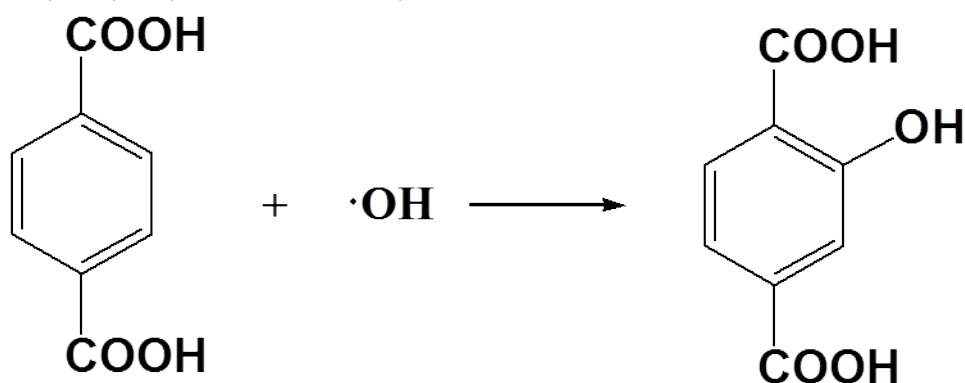
Product analysis

Liquid samples were filtered through a 0.45 mm filter. The liquid samples were then analyzed by HPLC equipped with a refractive index detector. Product separation by HPLC was conducted using an Aminex HPX-87H column (Bio-Rad) with 5 mM H₂SO₄ as an eluent flowing at 0.6 cm³ min⁻¹. The retention times and calibration curves were found using certain concentrations of products. The gaseous samples were analyzed through gas chromatography (GC-9790; FULL, China) by using a Spherocarb column measuring 1.5 m in length and 3 mm in diameter with temperature programming. The column outlet was connected to TCD. A methanizer was interposed between TCD and FID, which can convert trace concentrations of CO and CO₂ to methane, thus allowing detection on FID with enhanced sensitivity. H₂ was analyzed on TCD. Argon was used as carrier gas, and 1000 μ L of the gaseous sample was injected into the sampling port of the GC for H₂, CO, CO₂, and CH₄ analyses.

Determination of OH radicals

Terephthalic acid was used as a trapping molecule for the laboratory quantification of

photogenerated OH radicals in reaction system. Terephthalic acid reacts with OH radicals to yield 2-hydroxyterephthalic, reaction equation as follows.



So, OH radicals in the reaction system were measured by the terephthalic acid fluorescence probe, testing method as explained in the following. 0.04 M H_2O_2 was added into 200 ml 0.1M terephthalic acid aqueous solution with a concentration of 0.4 M NaOH. Then the measurements were performed under UV light irradiation using a 300 W high-pressure Hg lamp, took a sample every 5 minutes. photoluminescence(PL) spectra of luminescent 2-hydroxyterephthalic were obtained on a Hitachi F-7000 fluorescence spectrophotometer excited by 315 nm light.

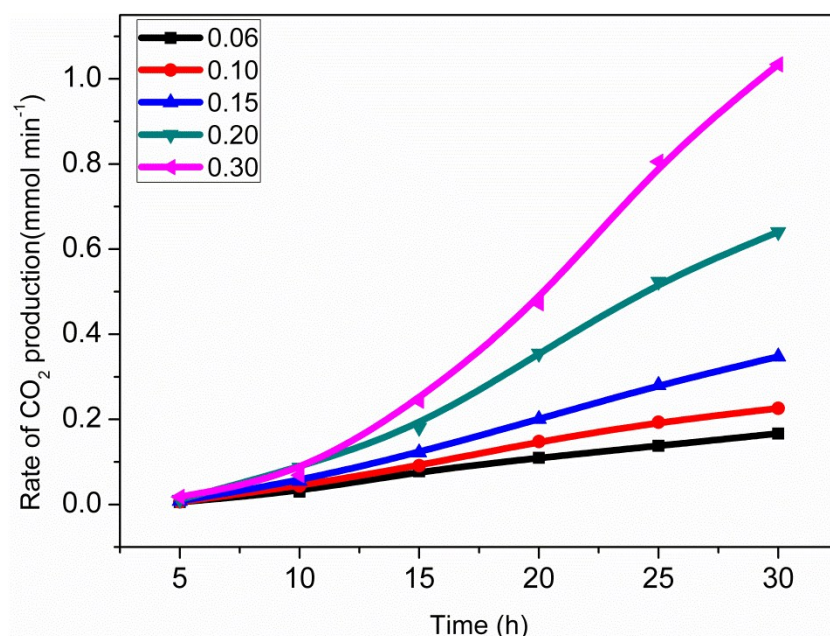


Fig. S1 Effect of the H_2O_2 supply on the production of CO_2 from the oxidation of lactic acid

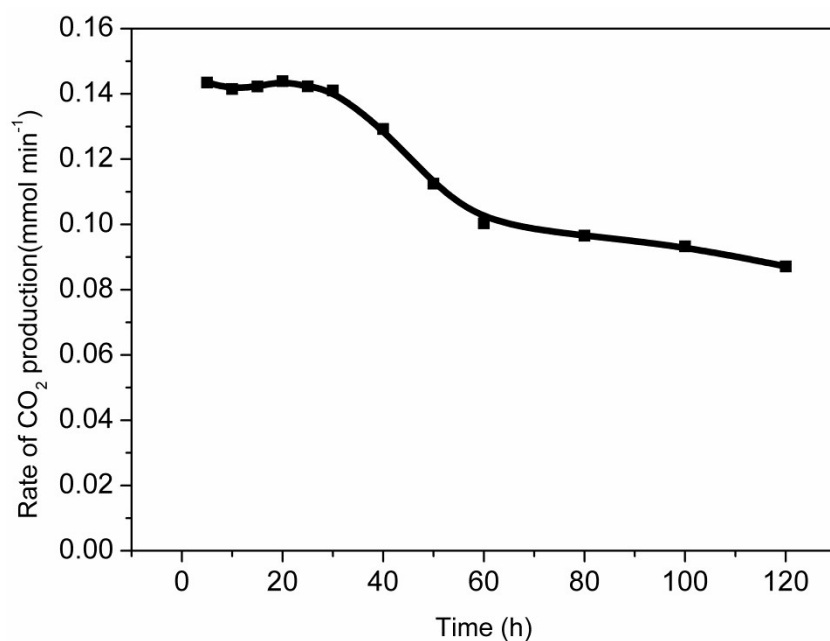


Fig. S2 Effect of reaction time on the on the production of CO₂ from the oxidation of lactic acid

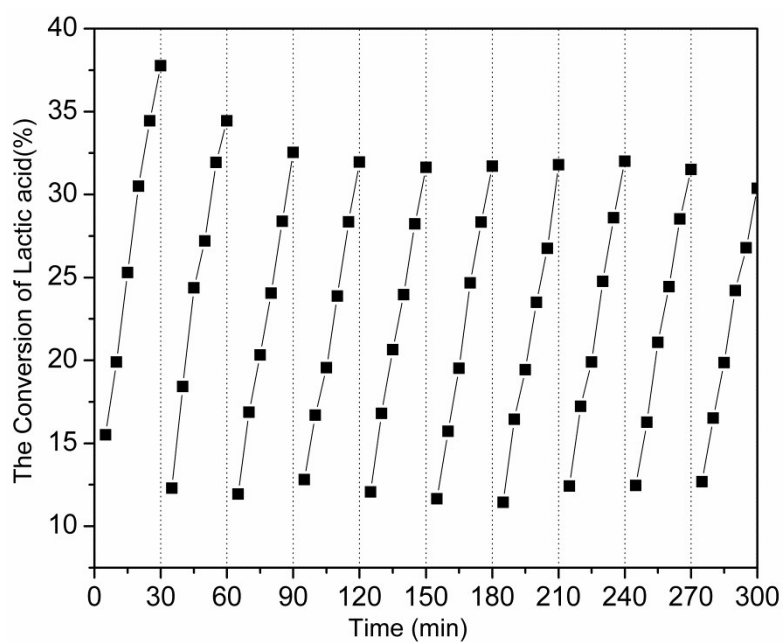


Fig. S3 The effect of the conversion of lactic acid by intermittent supplementation of 2 mL lactic acid and 4 mL H₂O₂,

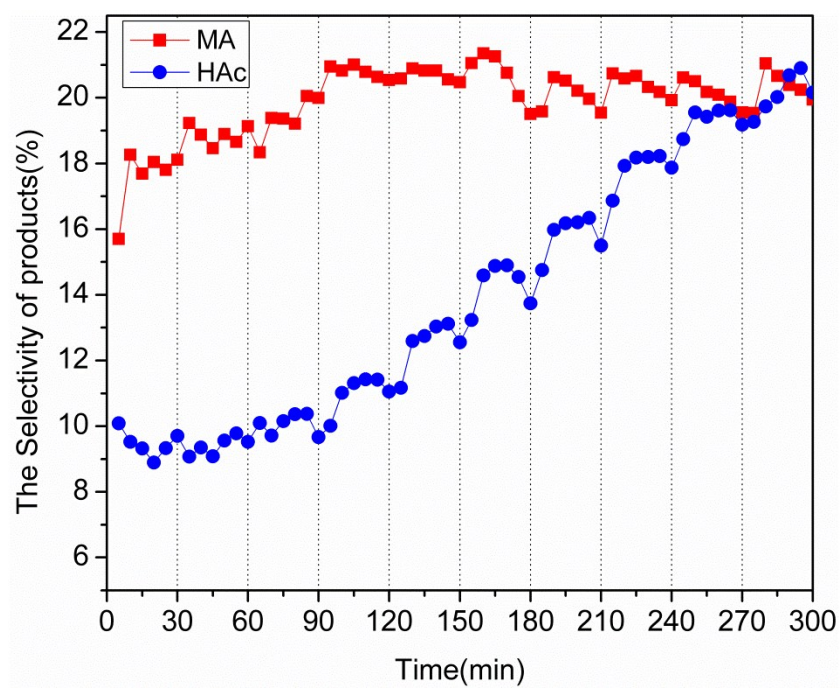


Fig. S4 The effect of the selectivity of mesoxalic acid and acetic acid by intermittent supplementation of lactic acid and H_2O_2