Bio-Based Production of Crotonic Acid by pyrolysis of poly(3-hydroxybutyrate) Inclusions

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ABSTRACT

Bio-based material development has become a new focus globally due to limited supply, increasing price of fossil fuel, and demands for environment sustainability. Current industrial production of crotonic acid through petrochemical route has several drawbacks: i) non-renewable, as it is derived from petroleum resource, ii) involves numerous complicated steps, and iii) produces low yield. Therefore, this paper proposes a method for production of bio-based crotonic acid by direct pyrolysis of bacterial poly(3-hydroxybutyrate) inclusion as an alternative to the petrochemical route. Thermogravimetric profile of poly(3-hydroxybutyrate) inclusions showed poly(3-hydroxybutyrate) degradation occurred at a temperature range of 270 °C–350 °C with maximum degradation rate at 310 °C. Analysis of products from isothermal pyrolysis of poly(3-hydroxybutyrate) at 310 °C revealed that pyrolysis of poly(3-hydroxybutyrate) inclusions yielded approximately 63% of crotonic acid. This is 30% higher than the conventional crotonic acid production via petrochemical method. The proposed method also offers other benefits such as renewable and simpler in processing. Besides, by-products of fermentation and pyrolysis are easy to treat, thus minimizing threat to the environment. Moreover, demands for bio-based products are expected to rise in the near future because of social, environmental and economical issues related to fossil resources which make bio-based production method more appealing and favourable. Therefore, pyrolysis of bacterial poly(3-hydroxybutyrate) inclusions provides new insight of renewable and green chemistry of the crotonic acid production.

KEYWORDS: Crotonic acid; Poly(3-hydroxybutyrate); Pyrolysis; Bio-based product

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